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ABSTRACT

The purpose of this project was to determine whether third grade students, given written directions and necessary materials, could work without teacher direction for 30 minutes. Students (N=25) were to gain skill and confidence in carrying out the processes required for completing an independent learning activity by completing science learning activity packets. The objective was to guide these students from the initial stage of seeking constant teacher direction to the end stage of seeking peer assistance and independence. Development of the learning activity packet included application of Gagne's nine instructional events and a formative evaluation. The packet was then implemented with the target population and a summative evaluation followed. The entire process followed the five stages of Instructional Systems Design. The introduction, analysis, design, development, implementation, evaluation, and summary and recommendations are included. A task analysis, independent learning activities development plan, a list of objectives sequenced and clustered into lessons, an entry behavior test, the pretest and posttest, a learning packet for six magnet activities, student answer packet, two attitude surveys with results, and teacher checklists for evaluating group and individual progress are appended. (KR)

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THE SCHOOL OF MEDIA AND ARTS

of

NEW YORK INSTITUTE OF TECHNOLOGY

announces the

Final Examination

of

Emily Geiger

for the degree of

MASTER OF SCIENCE

in

TRAINING AND LEARNING TECHNOLOGY

Independent Learning Activities in Science for Students At-Risk

Abstract

This document presents an examination of the analysis, design, development, implementation, and evaluation of an instructional unit on the use of independent learning activities in a science center. The designer applied the systematic approach outlined in the Instructional Systems Design process in the formulation of hands-on, self-paced learning activities. The instruction guides third grade students through the process defined for completing a science activity, while enhancing skills in following directions, decision making, and independent learning. Formative and summative evaluation techniques were utilized to ensure the best possible results. A complete description of the developement process is provided. Recommendations for use by other educators are presented.

Tuesday, September 25, 1990 at 4:30 p.m.

in

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Old Westbury Campus
Old Westbury, NY

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INDEPENDENT LEARNING ACTIVITIES IN SCIENCE FOR STUDENTS AT-RISK

a

THESIS/PROJECT

by

EMILY GEIGER

submitted to the faculty of the
School of Media and Arts

of

NEW YORK INSTITUTE OF TECHNOLOGY

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

TRAINING AND LEARNING TECHNOLOGY

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A Thesis/Project

submitted to The Faculty of the

School of Media and Arts

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CHAPTER 1

INTRODUCTION

Overview

Our nation is at-risk. Our students are at-risk. Schools are a reflection of our society. The school system is expected to address not only educational issues but current social ills as well. The past decade has seen increased concern for "at-risk" students, increased numbers of high school dropouts, increased drug use and AIDS, and decline of the traditional family structure. For many students, the schools are the most stable environment that they come in contact with. Students and communities are not static. They are constantly changing and schools must change with them.

New York State has mandated new curricula to address many of the current problems, focusing on education as a preventative measure. Perhaps the biggest focus has been on the identification of students who are at-risk of not completing high school. The Board of Regents and the New York State Education Department have published a working paper that identifies strategies to increase the chances of all students to complete high school. Increasing High School Completion Rates, a Framework for State and Local Action (1987) states:

> Dropping out may begin to occur long before a student is in high school...student motivation is an important ingredient in the schooling experience. However, a student's desire to do better can be ignited by a schooling experience that demonstrates a belief in a student's capacity to achieve.

Three of the strategies identified for increasing high school completion were:

1. Providing all students with a sense of identity and

self esteem.

2. Employing appropriate teaching strategies and learning environments.

3. Focusing on prevention; use of a developmental approach for teaching students in the early (K-3) and middle grades (State Education Department, 1987).

The State Education Department (1987) further states:

> Student self esteem is enhanced when students have numerous opportunities for successful academic and social experiences. All students should be encouraged to accept responsibility for their own learning, to solve problems, and to make decisions. Use of small group activities, tailored to the developmental levels of the students, develops self esteem and encourages participation. Development of logical thinking, organizational, and social skills, is the key to preventing at-risk students.

Background

For the teachers and students at Albany Avenue Elementary, Farmingdale Schools, New York, third grade is a transitional grade, moving from mastery of basic skills to application and use of these skills. Making decisions and working without teacher direction are necessary to increase the level of student performance. Ability to make choices and to persist in completing a task will prepare students for the demands of the intermediate grades: research projects, long-term assignments, and departmentalized classes. Building the skills and confidence of the students regarding independent work will lead to student exploration, risk taking, and will promote a sense of achievement among students.

The creation of a science activity center, where the students work with learning activity packets, will help develop the forementioned traits. The children work in small groups at their own pace. The center will include learning activity packets on:

magnetism, buoyancy, nutrition, digestion, and life cycles. Through the use of the center, the students will become more confident in their own abilities and realize that they are capable and trusted to work without the teacher. Following directions, problem solving, persistency, and confidence, are skills beneficial not only in the school setting, but in life as well.

Statement of the Problem

Generally students entering third grade are lacking the skills, or are not using the skills, needed for independent learning. The students are constantly seeking teacher direction and approval. They require constant reassurance and are uncomfortable and easily upset when asked to work autonomously. These characteristics limit the level of student performance and the variety of assignments that can be offered. The need for constant teacher direction also limits the amount of time the teacher can work with small groups and individual class members.

The problem facing the teacher is multifaceted: 1) to instill in the students the desire and confidence to work independently; 2) to teach students the skills and processes needed to complete an independent activity; and 3) for students to recognize when to appropriately seek help from the teacher.

Purpose of the Project

The purpose of the project was to enable students, given written directions and necessary materials, to work without teacher direction for 30 minutes. Students were to gain skill and confidence in carrying out the processes required for completing an independent learning activity. The objective was to guide these students from the initial stage of seeking constant teacher direction to the end stage of seeking peer assistance and independence.

Definition of Terms

The following terms are defined for their specific use in this project.

1. **Learning Activity Packet (LAP)**--A printed unit of instruction that is self-instructional in format. It should have an integrated theme and provide students with the necessary information to acquire and assess specified knowledge and skills (Dick and Carey, 1985).

2. **Students**--Third grade students in a heterogeneous, self-contained class at Albany Avenue Elementary School, Farmingdale School District, New York. Also known as the user and target populations.

3. **Science Activity Center**--The section of the classroom designated for independent and small group work. It houses the learning activity packets and all needed materials. Also known as the center.

4. **Materials**--Those items used by the students, including but not limited to the LAPs, science activity items, answer folders, and pencils.

5. **Independent Learning Activity**--Activities where students work without teacher instruction, but may include peer coaching and assistance.

6. **Grouping by Cooperative Learning Theory**--The process of ranking the students by desired skills and then forming groups by alternating from the top and the bottom of the list.

Assumptions

1. That the students using the learning activity packets in the science activity center are part of a heterogeneous, self-contained third grade class.

2. That the students have not previously worked with a learning activity packet.

3. That the reading level of the learning packets has been attained by all students.

4. That working independently is a skill that is transferable to future school and life situations.

Limitations

1. That the learning activity packet described in this project was designed for a heterogeneous, self-contained third grade class in Albany Avenue Elementary School, Farmingdale, New York. It may not be suitable for use in other settings without appropriate modification.

Method and Procedures

The method used to develop the learning activity packet was based on the Instructional Systems Design Model (ISD) from the Center for Educational Technology (1976). The primary focus of ISD is on what knowledge or skills the learner must attain by the end of instruction. Once this knowledge or skills has been identified, instruction is designed to sequentially present the material or skills to be mastered. The five steps of the ISD process are: analysis, design, development, implementation, and evaluation.

Analysis

The designer, a third grade teacher, observed the need for instructional materials to increase student skill and confidence for independent learning. An instructional goal and needs analysis were conducted. Coworkers were surveyed on the need for independent learning skills and on current student ability. Students were given an attitude survey and a complete learner analysis was performed. The instructional goal was then defined and a task analysis completed.

Design

Based on Gagne's (1985) nine instructional events, the instruction and learning activities were developed. Media used included printed materials, mock-ups, and physical objects. The method of instruction included teacher presentation, modeling and oral questioning, leading to self-paced independent learning. The choices for the media and methods were based on Anderson (1983). The LAP was continually developed throughout the implementation process.

Implementation

Following the instructional system that was designed and developed, the instruction was delivered to the target population. At this point the instruction was presentd to the class as a whole. The materials were then tested using a one-on-one trial, a small group trial, and a field trial. After each trial the materials and student performance were evaluated. Revisions were then made to more effectively meet the needs of the learners and teach the desired objectives. After the final trial the materials and instruction were again evaluated.

Evaluation

A design that has been implemented must be evaluated to determine if it was effective. The formative evaluation consisted of three one-on-one trials, one small group trial, and a field study which was to be four additional small group trials. The one-on-one trials were used to determine if the readability was acceptable for all students in the target population. After the first group was observed using the packet and student performance was evaluated, needed changes were made before the remaining groups used the LAP. The evaluation was an on-going process; evaluations were made after each small group trial. The summative evaluation was intended to be based on the final version of the LAP used by the fifth small group. The four levels of evaluation examined were: reaction, learning, behavior, and results.

Summary

A high school diploma should be attainable for all students in our public schools. Yet for many, the chances of completing high school are hindered by life situations and surroundings. New York State has identified characteristics of and strategies for identifying students at-risk. Schools must adjust themselves to meet the changing and distinct needs of the students. A means of addressing this challenge was the development of a learning activity packet to be used by a third grade class at Albany Avenue Elementary School in the Farmingdale School District. During the analysis stage, this population was observed to have many of the same characteristics seen in older students who have been identified as being at-risk: difficulty with decision making and staying on task, and a lack of independent work skills and self confidence. The design stage established objectives that the students would master by the end of instruction to reduce these undesired traits. Development of the learning activity packet included application of Gagne's nine instructional events and a formative evaluation. The packet was then implemented with the target population and a summative evaluation followed. The entire process followed the five stages of Instructional Systems Design.

CHAPTER 2

ANALYSIS

Introduction

Analysis is the first stage of the Instructional Systems Design process. The purpose of analysis is to detail the tasks that the learner will be able to accomplish when the instruction has been completed. There are three steps to the analysis stage which must be conducted.

The first step is a needs analysis. This determines if there is an instructional need based on present learner performance. It also determines whether the development of instruction and materials will solve the problem which originally led to the instructional need.

The second step is a job task analysis. The instructional need is broken down into its major components; the steps that are necessary for its completion. The designer then chooses only those tasks which are needed for instruction. Each task is then dissected into a series of steps that will complete the task.

The final step is a learner analysis. It is necessary to identify the major characteristics of the target population to design effective instruction. The entry behaviors, prerequisite skills, and required attitudes must be established. The group's general characteristics are helpful in planning instruction tailored to the group's needs.

Needs Analysis

The designer, a third grade teacher, observed that students were lacking the skills or were not applying the skills needed for independent learning. The designer also observed that she was constantly addressing the class as a whole, leaving little time for individualized instruction or help. In order to determine if this was a performance problem or an instructional problem, a needs analysis was conducted.

Observations of the students were made by the designer. Students' attitudes, behaviors, and reactions to independent work were noted. The results showed the large majority of students to be anxious, unorganized, and lacking the skills needed to perform an assigned independent task. These characteristics led to inappropriate and disruptive behavior in class.

A questionnaire, presented in an interview format, was asked of the four remaining third grade teachers. Two of the four teachers regularly scheduled independent work time for reading activities only. The other teachers had no independent work activities scheduled on a regular basis. All four teachers related the belief that most students did not possess the skills and confidence to work without teacher direction, and one of these teachers questioned whether this should be a concern.

Finally, interviews were conducted with the students from the target population. Only three of twenty-five students verbalized that they were comfortable and enjoyed working without the teacher. Factors which may have contributed to this need were that the students were not given opportunities to use skills necessary for independent learning and that the teachers did not have appropriate ready-made materials available to them for this purpose.

Job Task Analysis

The task analysis of the intended instruction was conducted. Six main components, or tasks, were identified as requiring instruction. These six tasks encompassed three learning domains; psychomotor, cognitive, and affective. The tasks were determined by the main sections of a science center activity packet, and were arranged sequentially. The tasks are as follows:

1.0 Determine the topic and steps for completion of the activity.

2.0 Locate and set up needed materials and equipment.

3.0 Perform the needed steps for the completion of the activity.

4.0 Evaluate the results for accuracy.

5.0 Complete a reaction sheet (optional).

6.0 Show confidence in working independently.

After the six steps were arranged, the subskills needed to complete each task were identified. Behavioral objectives were written for each of these subskills. For a further breakdown of each task, see Appendix A.

Target Population Analysis

The target population consisted of 25 third grade students, 12 girls, 13 boys, in the Albany Avenue Elementary School, Farmingdale, New York. The average age was 8.6 years. The ablilities ranged from learning disabled to four students in the gifted and talented program. IQ scores ranged from the two lowest, 74 and 77, to the two highest, 145 and 147. The reading grade level equivalents ranged from 2.1 to post high school. Using the SAT scores from the tests taken in second grade, the class was divided into three categories; above average, average, and below average. The results are listed in Table 1.

Table 1

SAT Results for the Target Population
Reading and Mathematics

	Above Average	Average	Below Average
Reading Comprehension	10	8	7
Mathematics Concepts	12	7	6

Grouped by their observed entry level abilities for independent work, the class was divided into four groups. Group 1 consisted of six students who had no problems with working independently. When given only the necessary instructions they quickly got organized and began work. They did not appear to be afraid to make mistakes and were capable of finding alternative ways to complete an activity if a problem arose. They were able to discriminate when they were truly at a dead end and then asked for help.

Group 2 consisted of eight students who were hesitant to begin independent work. After instructions are given, they asked an enormous number of questions, more for reassurance than for clarification. Once they were guided to begin, they were able to continue on their own.

Group 3 was very similar in needs to group 2; they asked questions for reassurance and had difficulty getting started. This group however needed feedback and reassurance throughout the activity. After each completed step they asked for the designer's approval, despite being reassured they they were proceeding correctly. There were seven students in this group.

Group 4 consisted of four students who, for different reasons, were almost incapble of working independently of the teacher. One student lacks self control. The student is not able to focus on the activity long enough to do any part of it. He needs constant reminders to refocus himself. Another student is highly disorganized. She is easily distracted and does not have the ability to act on something, remember it, and record it. Another student in the group has the abilities for independent work, but is an extremely slow worker. Despite reassurances, when he sees that he is behind his classmates, he panics and confuses himself in his efforts to hurry up. The last student possesses all of the needed abilities, but has no self confidence. He believes that he needs help and when asked to work without the teacher becomes upset to the point of tears. These groups, along with the results from the SAT scores, illustrate the tremendous range in abilities. It also highlights the need and level of instruction that is required for independent learning to take place.

Organizational Constraints

Using the media selection process presented by Anderson (1983), it was determined that printed materials and video were most appropriate for the intended instruction. The designer did not have access to video equipment, therefore the printed materials, aided by physical objects and worksheets, were included in a science learning activity packet.

The production of the activity packets, with all materials being created and adapted by the designer, was completed. A copier, available to the designer was used to produce two copies of the packet for student use. The designer used the packets for the one-on-one, small group, and field trials.

There were several projected constraints including: (1) the time required to create and adapt the materials for the LAP; (2) the limited supplies and available time for use of the copy machine; (3) that the activities were limited to the materials that were available for use; (4) the limited space that could be used to house the science center; and (5) the time each student could be allotted to work in the center.

The results were that only one of the intended five packets were produced and the designer purchased needed supplies and materials from her personal funds. Alterations were made to the initial design of the center to conform to the available space, and use of the center had to be scheduled on a weekly rather than a daily basis.

Instructional Goal

The purpose of this project is to provide instruction of a process for completing an independent learning activity. The goal is for students to become confident, productive, independent learners.

Given written directions and necessary materials, students will complete an activity in the science center. Students will work without teacher direction for a 30-minute period. Students will gain skill and confidence in completing the necessary steps required in an independent science activity.

Analysis of the Instructional Goal

There are two fundamental steps for analysis of an instructional goal. The first is to classify the goal statement according to the domains of learning that will occur. The second step is to describe what a student will be doing when performing the goal (Dick and Carey, 1985).

The instructional goal stated previously was classified as an intellectual skill, also encompassing the psychomotor and affective domains. Intellectual skills are those that require the learner to do some unique cognitive activity. Psychomotor skills are those where a learner must execute muscular actions, with or without equipment, to achieve specified results. The affective domain, or attitudinal goals, influence the learner to choose to perform an intellectual or psychomotor skill under certain circumstances (Dick and Carey, 1985).

The six main tasks needed to perform the instructional goal include: (1) reading and understanding the objectives and directions; (2) locating and setting up the required materials; (3) completing the activity sequentially; (4) evaluating the results; (5) completing an end of activity reaction sheet; and (6) feeling confidence in working without the teacher. The instructional tasks are classified by learning domains in Table 2.

Table 2

Learning Domains for Instructional Tasks

Intellectual	Psychomotor	Affective
1.0 Determine topic and steps for completion of the activity	2.0 Locate and set up needed materials and equipment	5.0 Complete a reaction sheet
4.0 Evaluate results	3.0 Perform the needed steps for completion of the activity	6.0 Show confidence in independent work
5.0 Complete a reaction sheet		

The media and instructional aids previously selected were assigned to each task with consideration of the domain of learning. The printed materials, including activity sheets, visual aids, and worksheets, all assisted in the teaching of the intellectual domain objectives. The advantages of printed materials are numerous, including: (1) students can stop at any point in the material to refer to other sources; (2) students can proceed at their own pace; (3) materials can be easily modified to meet appropriate reading levels; (4) students can easily review the materials; and (5) materials can be retained by the student or teacher for reference (Anderson, 1983).

The physical objects assisted in the mastery of the psychomotor skills, which in turn clarified the intellectual objectives. The manipulation of objects served several purposes: (1) to allow students to experience and practice a skill; (2) to utilize all of the student's senses, particularly the tactile sense; (3) to provide concrete examples for teaching sequential steps in an operation for completing a task; and (4) to act as a stimulus for motivation and active participation (Anderson, 1983).

Literature, Existing Course, and Material Review

For the intended use in this project, literature was defined as publications providing background and resource information on the topic. Materials were defined as publications usable in or adaptable for a classroom situation.

Before beginning the instructional design, a determination had to be made as to whether materials meeting the instructional goal were already in print. The instructional matrials needed to be appropriate for self-instruction for third grade classroom use in an elementary school.

Related Theory

The materials needed must take into account several factors: (1) that the instruction was designated as being the intellectual; psychomotor, and affective domains; (2) that students are working without teacher direction but with peer assistance; (3) that the learning is self-paced; and (4) that the students are ages 8-9 years.

In making media choices for effective learning, one must first identify the general characteristics of the instructional situation (Gagne, 1985). The media and materials selected for instruction must have the elements needed to communicate the instruction to the learner. Therefore, the designer must analyze the instruction with regard to the learning domains and intended outcomes.

Erik Erikson's psychosocial theory states that all humans have basic needs and that society must provide for these needs (Erikson, 1963). Erikson's fourth stage, industry versus inferiority, occurs in the school aged child. Children either feel competent or incompetent in the environment. They desire productive work on their own, seeing the relationship between steady attention and perseverance, and the pleasure of a job completed.

Piaget believed that children passed through a series of four stages of cognitive development. Each stage is associated with a specific age. The target population for this instructional goal falls into Piaget's third stage, the period of concrete operations. This stage, lasting from 7 to 11 years, is the hands-ons thinking phase. The basic characteristics are that the child can recognize

(1) the logical stability of the physical world; (2) that many elements can be changed or transformed and still conserve many of their original characteristics; and (3) that these changes can be reversed (Piaget, 1964). Children at this stage have developed a complete and logical system of thinking; however, it is still limited to physical reality, not abstract ideas. Logic is limited to those operations that can be organized, classified, or manipulated.

According to Bloom (1956), there is an hierarchy of levels at which students may think. The lowest level is the recall of basic facts or knowledge. It is believed that most learning is done at this level. Students should be encouraged to move to the higher levels, which include analyzing, evaluating, and transfering learning to new situations.

The theories of Erikson, Bloom and Piaget, along with the research of Gagne, support the ideas included in the intended instruction. Third grade students should be developmentally ready for independent work activities, if their needs are considered. A self-paced learning activity packet coupled with the manipulation of physical objects should allow each student to achieve maximum learning.

Literature Review

Sources used for a search of existing literature and materials were the ERIC (Educational Research Information Center) database, the Sayville Public Library, the libraries at Hofstra University and Dowling College, and privately owned texts and references.

The ERIC database listed thirty-five publications as a result of a search using the identifiers: primary or elementary education, learning modules, individualized instruction, science, mathematics, and self esteem.

The designer found materials in published text and resource books which, if adapted, could be included in the intended instruction. However, the designer did not find existing materials that were sufficient to meet all parts of the instructional goal.

1. Duane, J. (1973). Individualized instruction-programs and materials. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

This book is designed for teachers, media specialists, and administrators who are interested in learning about effective methods of planning, designing, and implementing individualized instruction programs. The book is organized into four sections. Part 1 deals with the problems encountered when changing from group oriented instruction to individualized instruction. Part 2 summarizes several instructional formats that are being used successfully throughout the country. Part 3 outlines the characteristics of various types of media and suggests methods for integrating the media into the individualized instruction. Part 4 concerns itself with means of evaluating individualized instructional programs and presents some criticisms of existing programs. A bibliography is provided at the end of each section.

2. Darrow, H. and VanAllen, R. (1961). Independent activities for creative learning. New York: Bureau of Publications Columbia University.

The book was developed as an aid to classroom teachers who desire to place a greater emphasis on creative self-expression. Suggestions are given for effective ways of organizing the classroom for independent activities and activities which promote creative thinking. The activities included require minimum preparation and most of the materials needed are inexpensive and readily available in most schools. Descriptions of how skills are developed through activities are given. Emphasis remains on independence.

3. Petreshene, S. A complete guide to learning centers. (1978). Palo Alto, CA: Pendragon House Publishers.

This book is a how to do it approach for organizing, constructing, and operating a learning center. Centers for all subject areas are presented. The book begins by presenting a philosophical basis for learning centers. Sections include: (1) problems that must be resolved in establishing an effective individualized approach to teaching; (2) samples of activities and development of a sequential individualized curriculum; (3) time schedules; (4) means of determining student needs; and (5) record keeping methods. The focus is on individualized instruction while maintaining structure and organization.

4. Bechtol, W. (1973). Individualizing instruction and keeping your sanity. Chicago: Follett Publishing Company.

The purpose of this book is to help teachers and administrators develop skills needed for individualized instruction. It presents a total program for individualizing instruction. Three models that provide the conditions for individualized insrtuction are described: (1) the continuous progress, or nongraded, model; (2) the open school model; and (3) the Individually Guided Education (IGE) model. Competencies needed by teachers are also identified and described. These include criterion-referenced teaching, assessment strategies, identification of student learning styles, use of various learning modes, and management strategies. Appendices are included which provide information on many training programs for gaining skills for individualizing instruction.

5. Stahal, D. and Anzalone, P. (1970) Individualized teaching in elementary schools. West Nyack, NJ: Parker Publishing Company.

The major purpose of this book is to provide some specific, concrete suggestions for putting theory about individualized instruction into effective practice. It included many ideas for modifying standard classroom procedures which teachers may wish to adopt. The book is organized in four parts. The first part focuses on the rationale for individualized instruction and some of its implications in terms of the role of the teacher. The second part presents strategies for individualization. Specific techniques for implementing the programs are given in part 4 with examples from many subject areas and grade levels. The final section of the book focuses upon various aspects of providing and preparing instructional materials to be used in a program of individualized instruction.

6. Votaw, T. (1986.) Teaching K-6 science in small schools on a financial shoestring. ERIC Digest, pp. 1-4.

The purpose of this article is to present ideas for expanding science resources in a school and to improve the teaching of science. Suggestions are given for ways of obtaining inexpensive and free materials, while involving students, parents, and community members. Specific ways for organizing the materials and expansion of existing files are included. Development of learning modules is explained, including materials needed, time schedules, and anticipated problems. The article concludes by presenting some of the arguments for and against the use of modules for the teaching of science.

7. Glasgow, D. and Carson, R. (1986.) Minicourses, maxibenefits. Science and Children, pp. 21-23.

The article presents a program adopted by the the Little Rock School District to encourage the teaching of science. A four-part program which included minicourses and science loan kits was made available to elementary school teachers. Inservice credits were given to the teachers who participated. Each course lasted three hours, and each course was designed for a specific grade level and areas of study. Teachers can choose the number of courses they want to take. Teachers were then encouraged to develop minicourses in other areas not already being addressed. The teachers all were given the loan kits at the completion of their course to use with their students. All needed materials were provided and a resource center was established. The results showed an increase in the amount of science being taught and in the level of student participation. Standardized test scores in science have risen steadily over the last five years.

8. Office of Educational Research and Improvement. (1988). Science education programs that work. Washington, DC: National Diffusion Network.

This catalog contains descriptions of the science education programs in the National Diffusion network. These programs are available to school systems or other educational instititutions for implementation in their classrooms. Information about the National Diffusion Network is provided along with programs in the followirng areas: (1) conservation for children; (2) foundational approaches in science teaching; (3) geology; (4) hands-on elementary science; (5) informal science study; (6) life lab science study; (7) marine science; (8) physics; (9) astronomy; and (10) biology. A description of each program is given with the grade level designated and teacher and material requirements. Costs per student are provided, as well as training programs that are available.

9. Astronomy Education Materials Network. (1985.) Astronomy education materials resource guide. Morgantown, WV: West Virginia University.

This publication promotes the teaching of astronomy by providing a systematic approach to obtaining educational materials. A rationale for the use of hands on materials is presented. Research found that three types of instructional activities are needed for effective learning: (1) experience and active data gathering; (2) model building, discussion and reading; and (3) introduction of concepts, generalizations, and theory. Materials representing over 100 separate sources are given. These materials include instructional modules, lab and field materials, video tape presentations, games, simulation, planetarium lessons and labs, and computer programs.

Survey of Existing Courses and Materials

1. Forte, I. and Pangle, M. (1973). Center stuff for nooks, crannies, and corners. Nashville: Incentive Publications, Inc.

This book is a resource of materials to be used in independent learning centers. It is a sequential teacher's guide book providing step-by-step directions for planning and implementing a wide variety of classroom learning centers. Each of the model learning centers presented contains performance objectives, lists of needed materials, procedures for implementation, student activity sheets which can be duplicated, illustrations, and an actual photograph of the centers in use. Appendices are included for reinforcement activities and additional help to teachers who want further information on center use. Games, puzzles, quizzes, brain teasers, and additional ideas are also offered.

2. Brewer. A.C., and Garland, N. (1972). Elementary science-learning by investigating: Book 2. Chicago: Rand McNally & Company.

This is a series of books, presented in lesson format, on different units in science. Information is presented to students in story and experience form. Activities using the information are included, along with vocabulary and questions to think about. There is also a record book which compliments the text. This includes additional activities which the students can complete directly in the record book. The unit topics included in Book 2 are: (1) Fall; (2) Sun and Shadows; (3) Forces and Systems; (4) Magnets; (5) Spring; and (5) Life Cycles of Animals.

Plan for Design and Development Effort

The results of the analysis phase showed a need for proceeding with the design, development, and implementation of the instructional program.

Estimated Student Effort

Estimated student effort was ten hours. Initially, the students must be taught how to use the science center and the learning activity packets. The instruction consisted of six lessons averaging fifty minutes each. These lessons were generic; they introduced and taught the packet format, location of materials, and the process for completing a LAP, regardless of the unit of study.

Once students were in the science center working independently of the teacher, the learning activity packet Magnets averaged seven forty-minute periods. Six forty-minute periods was the minimum number needed to complete the packet. This number was extended when a student needed more than one period to complete an activity or if it was determined through the evaluation that an activity needed to be redone.

Project Plan

As a means of organizing the different stages of the project, a time frame was established. Both PERT and Gantt charts were designed to schedule and correlate the various activities. The first step, needs assessment, began on October 13, 1988. The last step, summative evaluation and final report, was completed on May 12, 1989.

Use of the charts helped to diminish any possible conflicts and delays. The designer followed these time schedules to complete the project by the projected end date. The PERT and Gantt charts are illustrated in Appendix B.

Budget

The budget for the instructional program included funding for the salary of the designer/instructor, the acquisition of learnng materials, and the development of the learning activity packet. The prorated salary was based on the instructional time at $30.00 per hour. The instruction of the learning activity packet took six fifty-minute periods. Grading and evaluation of student work totaled 20 additional hours; 4 hours for each group of five students. Classroom costs included the purchase of magnets, containers, labels, stickers, and carpet. The results are summarized in table 3.

Table 3

Budget for the Instructional Program

Expense	Hours	Cost	Subtotal	Total
Labor				
Analysis	90	$ 2,700.00		
Design	75	$ 2,250.00		
Development	100	$ 3,000.00		
Instruction	26	$ 780.00		
Evaluation	100	$ 3.000.00		
Total Labor			$ 11,730.00	
Materials				
Printing		$ 25.00		
Supplies		40.00		
Total Materials			$ 65.00	
Grand Total				$ 11,795.00

Summary

During the analysis stage of Instructional Systems Design, a needs and task analysis were conducted to determine the need for the development of instructional materials. Materials were needed to teach the skills for completing an independent learning activity packet. The instructional goal was defined and instructional events developed within the intellectual, psychomotor, and affective domains of learning.

The target population was analyzed focusing on characteristics, observed behaviors, and acquired degree of skills. It was as a result of this analysis that the designer formulated the instructional goal. Media and methods most appropriate for instructing the target population and for the type of instruction were determined. The media selection consisted of a learning activity packet to be used with science activities in a small group setting.

A review of existing literature and materials was researched for possible inclusion in the intended instructional materials. A time line was developed and closely followed to meet the projected end date. The chapter concluded with the estimated budget for the instructional program.

CHAPTER 3

DESIGN

Introduction

The design stage of the Instructional Systems Design detailed the particular knowledge, skills, and attitudes that the learners will have attained by the end of the instruction. Specified during the design stage were the instructional objectives and their subtasks. These objectives were defined in terms of desired performance, conditions, and criteria for learning. They were also sequenced into a logical order for mastery. The conditions for the intended instruction and student entry-level behaviors were also defined. The design stage concludes with the evaluation methods and materials that are included in the instructional process.

Instructional Task Analysis

During the analysis stage, the instructional goal was defined as an intellectual skill, encompassing both the psychomotor and affective domains as well. A job task analysis of this goal was completed during that stage, resulting in a list of tasks that the learner must perform in order to successfully master the instructional goal. All the necessary tasks for completion of the goal must be included, and all unnecessary tasks excluded. Six main tasks were identified as being necessary to accomplish the goal of completing an independent learning activity. The subskills needed to perform each of the tasks were then identified with behavioral objectives written for each of these subskills. The result was the structure used for the instructional design. The complete task analysis is presented in Appendix A.

Instructional Objectives

An instructional objective is a clear, precise statement of what a learner will be able to do at the completion of instruction. The objectives should first describe what the learner will be doing at each step of the instruction, the subordinate objectives, and what the learner will be doing to meet the intended results, the terminal objectives (Mager, 1985). These instructional objectives are derived from the instructional analysis. There is a minimum of one objective for each of the identified tasks.

According to Mager (1985), the objectives should include three main parts: performance, conditions, and criteria. The skill to be performed must be stated in observable terms which can be measured for evaluation. The conditions under which these skills are to be performed must be given. These conditions may include materials to be used, time stipulations, and the setting. Finally, the criteria for assessing performance must be stated. This is the degree and conditions of mastery expected. The designer identified the objectives, both subordinate and terminal, which correspond to the six main tasks of the instructional goal.

1.0 Students will determine the topic and steps for completing the activity.

1.1 Given access to the science center, students will locate the science activity. Location must include holding a copy of the activity in hand.

1.2-1.3 Students will read the overview section and given a response sheet, write the topic and objective on the sheet. The topic and objective must match that on the activity.

1.4-1.5 Students will read the direction sequentially and given a direction check sheet, complete the check sheet. The worksheet will be completed when the directions are sequentially recorded.

1.6 Given the correct answers, students will check their direction worksheet. All student answers must match in sequence to those on the answer sheet.

2.0 Students will set up the needed materials and equipment.

2.1-2.2 Given access to all materials in the science center, students will locate the needed materials for the activity. The located materials will be retrieved and brought to the work table. All needed materials must be placed on the work table before beginning the activity.

3.0 Students will perform the steps needed to complete the activity.

3.1 Given the directions, access to the materials, and a response sheet, students will sequentially complete each step in the activity procedure. Each step upon completion must be checked off on the response sheet.

3.2 Given a response sheet, students will record their findings when indicated to do so. Responses must be completed according to the specified directions.

4.0 Students will check their results of the completed activity for accuracy.

4.1-4.2 Given access to the results, students will locate the answer key and read the findings. Location includes holding the correct answer key in hand.

4.3 Given the completed activity and the answer key, the students will compare and contrast the new information to that on the key. The contrasts and comparisons listed on the response sheet must contain references to all points recorded on the answer key.

5.0 Students will complete a reaction sheet.

5.1 Given access to the reaction sheets, students will locate one form. Location must include holding a sheet in hand.

5.2 Given a reaction sheet, students will complete the sheet. The reaction sheet will be completed when the heading and questions 1-3 are answered. Question 4 is optional.

5.3 Given the completed response sheet and reaction sheet, students will turn the activity sheets in to the teacher. The sheets must be stapled and placed in the "completed work" box.

6.0 Students will show confidence in working independently.

6.1-6.6 Given the opportunity to work independently in the science center, students will show confidence in their work. Confidence will include, beginning work without hesitation, seeking less teacher assistance, helping peers, smiling, and applying skills in other areas.

Entry Behaviors Defined

Entry behaviors are those skills a learner must have before beginning instruction. For the instruction to be effective, the designer must identify the skills that are necessary and match student ability and materials. When entry behaviors are not already mastered by the majority of the learner population, instructional materials may be ineffective and learners may become easily frustrated. When instruction includes skills that have already been mastered, instructional materials may be boring for the learners (Dick and Carey, 1985).

The designer identified three entry behaviors for beginning instruction on completing an independent learning activity in the science center.

1. Identify materials found in the science center.
2. Read at the 2.0 grade level equivalent.

3. Define contrast and compare.

These entry behaviors would not be included in the intended instruction. However, they are identified and written in behavioral terms in case the need arises for these to be taught to specific learners.

Group and Sequence Objectives

The six terminal instructional objectives correspond to the six main tasks for completing an independent learning activity. The main tasks, when written during the analysis stage, were placed in a logical sequence. These tasks were arranged to match the order of the steps needed to complete the activity packet. The objectives for these tasks and the subskills were clustered by topic, and the content of each cluster was analyzed. The amount of time predicted to teach each cluster of skills was estimated. The order of the tasks to be taught was determined and the instructional objectives matched. The sequence of the tasks and objectives remained the same as the original task order. However, for instruction, some of the main tasks were combined into one instructional lesson. Other tasks were repeated during instruction to ensure mastery of the skills. The objectives are listed in sequence in the Instructional Objectives section of this thesis. Lessons with the subskill clusters are further illustrated in Appendix C.

Learning Activity Specification

The time period for completing a science learning activity packet is six forty-minute periods, averaging one period for each acitivity in the packet. The instruction on how to complete a single activity required six lessons, averaging fifty minutes each. These fifty-minute lessons included an introduction, recall of information, presentation of new information, student practice, and feedback. During learning, there are nine internal processes that occur which have been identified by Gagne (1985). These internal processes are supported by the instructional events. Together, a complete lesson plan is frameworked. The internal processes, the instructional events, and the components of a lesson plan are paralleled in Table 4.

Table 4

Internal Processes, Instructional Events, and the Lesson Plan

Internal Process	Instructional Event	Lesson Plan
1. Reception	Gain attention	Gain attention/ motivate
2. Expectancy	Inform learner of objectives	Tell learners what they will be able to do
3. Retrieval to Working Memory	Stimulate recall of prior learning	Relate lesson to previous class knowledge
4. Selective Perception	Present stimulus	Present learning activity
5. Semantic Encoding	Provide learning guidance	Organize/ demonstrate the activity
6. Responding	Elicit performance	Learner performs the activity
7. Reinforcement	Provide feedback	Give information feedback
8. Retrieval and Reinforcement	Assess performance	Tie together concepts and generalizations
9. Retrieval and Generalization	Enhance retention and transfer	Evaluate; provide reviews

The instruction utilized the first unit from the learning packets. Each lesson was related to one or more of the instructional objectives previously stated in the Instructional Objectives section of this thesis; the objective clusters. It was necessary to develop an instructional delivery which encompassed the appropriate media and methods for eliciting the desired student performance. Table 5 summarizes the instructional objectives related to instructional methods and media.

Table 5

Relationship of Method and Media to Instructional Tasks

Instructional Task	Method	Media
1. Determine topic and procedure for completing the activity	lecture modeling questioning note-taking	printed materials mock-ups chalkboard
2. Set up needed material	modeling demonstration questioning	printed materials physical objects
3. Complete the activity	lecture modeling small groups	printed materials physical objects chalkboard
4. Checks results for accuracy	lecture modeling	printed materials overhead transparancy
5. Complete a reaction sheet	lecture in-basket-technique	printed materials

The primary media used were printed materials and physical objects. Printed materials included the learning activity packet, mock-ups, transparancies, and chart. Information sheets, and work forms were used by the students. The advantages to printed materials include (Anderson, 1983):

1. Students can stop at any point in the material.
2. Students can proceed at their own pace.
3. Materials can be easily modified.
5. Students can easily review materials.

The physical objects were used for identification of materials, modeling of manipualative skills, and for actual center experience. The advantages to physical objects include (Anderson, 1983):

1. Students are able to experience and practice skills.
2. Students utilize all of their senses, particularly, tactile.
3. Students are provided with concrete examples for learning.
4. Objects act as a stimulus for motivation and active participation.

Teacher presentation, modeling, and oral questioning were the main methods of instruction. Students used brainstorming, cooperative learning, and actual experience for practicing the new skills. Note-taking and the in-basket technique were also utilized.

Preinstructional activities, information presentation, student participation, testing and follow through activities, were all part of the instruction strategy. Throughout the design stage, the designer considered the target population. Reading level, size of print, information presented, and amount of time for each lesson were caefully monitored. A variety of methods and media was used to account for differences in learning styles, and active participation was stressed due to the age and developmental stage of the learners.

Assessment System Specification

At the time of instruction, learning must be measured. The insructional design must predetermine what will be used for assessment and at what points during instruction . An entry behaviors test, pretest, progress checks, post tests, and attitude surveys were all included in the instruction.

Entry Behavior Test

An entry behavior test was administered to all students before they were allowed to begin the individualized or group work: subskills 2.1-2.2. Each student was asked to identify the materials that are located in the science center by verbal request. They were also asked to explain what is meant by "compare and contrast". A checklist was completed by the teacher (Appendix D).

Pretests

A pretest was administered. The test was a series of written direction which the student must follow. This helps to illustrate the importance of reading, understanding, and following the directions. This pretest paralleled steps 3 and 4 in the instruction and helped determine student ability (Appendix E).

Post Tests

Many forms of post tests are used during the instruction. Observations made by the teacher determined if students were able to locate materials, follow directions, and complete the activity sequentially. Checklists were used to evaluate steps 2 and 3 of the instruction; setting up materials and completeing the activity. Forms completed during the activity were evaluated by the teacher and conferences were held to establish the comfort level and reactions of each student (See Appendix F).

Embedded Test Items

No embedded items were used. Because this instruction is teaching independent work skills, students need feedback on all performance and work that is completed. For those students who repeatedly complete a section of the procedure incorrectly as determined by the checks built into the activities, teacher directed activities are needed. When step-by-step practice with the teacher is successful, the student is assigned a partner for working in the center. After time, the student is weaned off the partner.

For the more able student, the intermittent, or progress checks, are removed allowing the student to complete the activity from beginning to end, truly independently. These students are also assigned as a partner for those who are less able or as group leaders, answering questions and trouble-shooting for those in their group. The assessments help to ensure that all students are mastering the objectives necessary for completion of the instructional goal.

Evaluation Systems Specification

Following the completion of the design of instruction, the instruction must be evaluated to determine its effectiveness. The instruments of data collection mentioned in the previous section of this thesis, must be utilized and the results analyzed and interpreted. The two types of evaluation used in this instructional design were formative evaluation and summative evaluation.

Formative Evaluation

Formative evaluation is the collection of data and information during the development of instruction which can be used to improve the effectiveness of the instruction (Gagne,1985). The three types of formative evaluation used are a one-on-one evaluation, a small group evaluation, and a field trial evaluation.

The one-on-one evaluation was used to determine the readability of the activity packet and whether the directions would be understood by all students. The evaluation was completed by using three students with varying reading abilities: above average, average, and below average. Each student was asked to read the activity and then orally paraphrase the conditions and steps to be followed.

The small group evaluation and the field evaluation consisted of the same procedure due to the nature of the instruction. After the center had been introduced and instruction given to the class as a whole, the students were divided into five groups using the cooperative learning theory of selection. One group was then randomly chosen to serve as the subjects for the small group evaluation. They used the learning activity packet in the science center. Observations and evaluations were made of preformance and materials during and after each activity. Needed changed were made before the next group used the center and LAP. Each group was in turn, observed and evaluated.

Data collected from the formative evaluation included the following:

1. test data from progress checks and post tests
2. teacher observations and checklist results

3. time required to complete each activity

4. written and verbal reactions from learners.

Summative Evaluation

A summative evaluation is conducted to determine whether the instruction and materials designed are effective. Data that has been collected is analyzed, often statistically, to determine whether learning has taken place. After the summative evaluation, the designer must make a decision about the instruction's continued use. Kirkpatrick's (1987) approach for classifying areas of evaluation was used. The summative evaluation consisted of four levels: reaction, learning, behavior, and results. All data collected during the formative evaluation is used to determine the end results of the instruction; if significant learning has occurred.

Learning Transfer System Specification

The goal of the designed instruction was for students to become confident, effective independent learners. To ensure that the skills and procedures learned during instruction are used after the completion of the LAP, students will be exposed to new independent activities. Classroom centers for a variety of subject areas can be set up, as well as individualized instructional activities. The most critical element for ensuring that the skills are maintained, is for students to be exposed and experiencing independent learning on a continual basis; to practice skills and become more and more proficient in the needed procedures (Broad, 1988).

Review and Selection of Existing Materials

During the analysis stage, a review was conducted to determine whether any existing materials would be selected for possible inclusion in the instructional materials. Two publications were found to have materials that were suitable for the instructional materials, after being adapted to meet the specified needs of the intended learners.

1. Center Stuff for Nooks, Crannies, and Corners

This resource book presented ideas on how to set up a science center and suggested activities. Sample activity sheets were included. Activity sheets from the unit on magnets were adapted and used in the LAP. The activity sheets presented in the book were not sufficient without some modifications.

2. Elementary Science-Learning by Investigating

This is a science series which includes a text type book and a record book for science activities at the appropriate reading level for this instruction. Sections of the text from the magnet chapter were used in the LAP to present information to be used with the hands-on activities. Answer sheets from the record book were adapted for use in the LAP. This reference alone did not include an ample number of activities to meet the needs of the instructional goal. They required adaptations and being combined with additional materials.

Summary

The intended goal of the instructional program was categorized as an intellectual skill, including the psychomotor and affective learning domains. The design stage of Instructional Systems Design began with a task analysis of this goal. The result was the determination of five main tasks which were further dissected into subordinate tasks. Behavioral objectives were written for each of the required tasks for completing an independent learning activity. The objectives were then sequenced in the order needed to complete the activity and clustered by common objectives. Gagne's internal events were compared to instructional events and lesson plan components. Choice of methods and media used during the instruction were also identified. The designer used several means of evaluation, including an entry-behavior test, pretest, and post tests. Both a formative and summative evaluation were conducted. The design stage ended with the rationale for the partial inclusion of two existing publications within the learning activity packet.

CHAPTER 4

DEVELOPMENT

Introduction

During the third stage of the Instuctional Systems Design, development, the designer used the instructional strategy to produce the instructional materials. The instructional and evaluation materials were developed, reviewed, and evaluated. The results of this development were teacher presentations of information and a learning activity packet for use with the target population.

Learning Activity Development

Development of a learning activity packet for individualizing instruction requires a great deal of time and attention. Although the science center will contain five learning activity packets, only one was developed to be tested for instructional worth. The packet Magnets was developed, containing an introduction and six activities. A checklist presented by Vinskey (1979) in his book on individualizing instruction was used as a guideline. The checklist items included:

1. The student will be able to experience success by working on activities that match his ability and previous learning expriences.
2. The student will not be frustrated or haunted by fear of failure.
3. Styles of learning will be accomodated through the use of a variety of media and methods.
4. All students will work at their own pace.

5. Student motivation will be increased because they are working on activities which interest them.

6. Student-teacher relationship will be closer due to frequent one-on-one discussions.

7. Evaluation of materials and student achievement will be an on going process.

Once the learning activity packet was developed, the designer consulted two colleagues who also teach the content of the packet; a third grade teacher and the science teacher of the primary grade lab. Both agreed that the directions in the packet were easy to follow and that the activities were appropriate and sequenced properly. The feedback was positive regarding attractiveness, interest level, and motivation. The science teacher suggested using a heavier grade paper to make the packets more durable. This suggestion was taken into account.

Once the learning activity packet was developed, lessons to instruct the target population in the use of the packet were developed. The five main steps required for completing an activity were the content of these lessons. The five steps are:

1. to determine the topic and steps needed for completion of the activity
2. to locate and set up needed materials and equipment
3. to perform the needed steps to complete the activity
4. to evaluate the results for accuracy
5. to complete a reaction sheet

Lessons were developed to teach the five steps for completing any activity in the packet, regardless of the content. The steps needed to be taught in sequential order, start to finish, following Gagne's nine internal events.

Learning Activity Development

The learning activity packet Magnets was the media used for instructing the target population on the process for completing an independent learning activity. Only the first two activities of the packet were used during teacher presented instruction. Activities 3-6 were used by the students in the center. The instructional plan, presented by instructional event, follows.

1. **Gain attention**--The science center with all of its materials was set up for the students to see and investigate. An entry-behavior test was given to see if the students could recognize the materials in the center. This focused their attention and naturally led them to ask what they will use these items for; an introduction to the objectives.

2. **Inform learners of objectives**--During a review of the entry-behavior test and a class discussion, the students were told that they would be working, with peers, in the science center. Their goal is to complete the science activity packet without constant teacher direction. The Magnet packet is diplayed and the introduction read. At this time a pretest was given on following directions. This is reviewed with the students to stress the importance of reading, understanding, and following directions.

3. **Stimulate recall of prior learning**--A review of following directions is conducted through a question and answer session. The first activity, the introduction, includes a recall of any information known about magnets. This is done as a class, asking students to share knowledge. This helps to relieve anxiety and promotes excitement.

4. **Present stimulus**--The first activity is now presented.

Students are shown the materials, the set up of the center is explained, and the procedure for completing an activity is taught. The teacher served as a model using student volunteers as helpers.

5. **Providing learning guidance**--The students, in small groups, now practice what was learned, using activity 1. The teacher again serves as a model. The class works through the activity, each group working simultaneously, sharing ideas and reactions. At the completion, results are shared and a question and answer period held. Notes are recorded.

6. **Elicit performance**--After a review of the process learned, each group works independently of the others on activity 2. The teacher now serves as facilitator. Students are required to complete all of the steps of the procedure, necceassary worksheets, and answer forms.

7. **Provide feedback**--A class discussion is held to provide immediate feedback and for students to express their reactions. All written work is collected and evaluated by the instructor/designer. These are returned to the students to provide more tangible feedback that is more individualized than that given during the class discussion.

8. **Assess performance**--The collected written materials enable the instructor to assess performance, along with the observations made during the work on the activity. This is true also when the students work in the center; the written work is collected and assessed.

9. **Enhance retention**--A post test of the required steps is included in the instruction. These steps are further reviewed in a class discussion and note-taking. The students would

practice these skills when working in the center on activities 3-6.

The designer anticipated 5 weeks for the development of matrials and instruction. The development was completed within 4 weeks.

Pretest and Post Test

The development of the instructional materials began with an entry-behavior test. The entry-behavior test was a checklist used to determine if each student could identify the materials in the science center (Appendix D). Students may not begin work in the center until the entry-behavior test is mastered. A pretest on following directions was given to highlight the importance of reading, understanding, and following directions (Appendix E). This aids the instructor in anticipatiing problems for students once they are working in the center. A post test was used to measure whether students have learned the five steps of the procedure for completing an activity (Appendix F). It is given at the end of the class instruction, before starting work in the center.

Learning Activity Packet

The learning activity packet contained information on one topic--magnets. The information was grouped as follows:

General
    Introduction
    Properties of magnets
    Strength of magnets
    Uses for magnets
Specific
    Types of magnets

Objects magnets will attract/repel

Reactions of magnets;poles

Shapes of magnets--points of attraction

Materials which may interfere with attraction

Magnetizing objects

Uses for magnets

Each specific topic was a separate activity which began on a new page. Information was first presented, followed by work activities for students to complete (Appendix G). Each activity, one per week, is turned in for teacher evaluation when the student feels it is completed; progress checks. A sticker was placed on the progress chart when an activity is satisfactorily completed.

Reinforcements, both written and verbal, were part of the the design of the instruction. Upon completion of the entire packet, the student received a certificate of accomplishment which was signed and dated by the teacher.

Post Learning Questionnaire

Two reaction sheets were developed to assist the designer in the review of the instruction and the LAP (Appendix I). The first is given with the post test at the end of the whole class instruction. This reaction sheet measures student attitudes, motivation, and comfort level regarding beginning work in the center without the teacher. It helps the instructor formulate workable groups and anticipate students who may need further reinforcement and encouragement. The second reaction sheet is completed by the students at the end of each activity packet. This sheet helps to evaluate each activity packet for perceived clarity of directions, interest level, and problems. It also provides an opportunity for students to express personal comments and reactions which can be further discussed at the conferences.

Learning Activity Review

The learning activity packet, along with the intended instruction, was again reviewed by the science lab teacher for appropriateness of content and sequencing. The designer then reviewed the packet for clarity, appropriate vocabulary and grammar, and correct spelling. The sequencing of activities and consistency of progress checks was also re-evaluated. Answer sheets were reviewed for appropriate writing space and correspondence with the LAP. The center was then checked for all needed materials, organization of materials, and appropriate work space.

Materials for Evaluation Produced

During the development stage, two complete copies of the learning activity packet were made for use during the formative evaluation stage. Each packet consisted of an introduction and six activities on the unit Magnets.

Summary

During the development stage, the learning activity packet was developed based on individualizing instructional methods and steps for meeting the instructional goal. The packet included one topic, magnets, and was developed in a sequential manner. Teacher led instruction was developed using Gagne's nine internal events as a guide for the needed instructional events. Included were an entry-behavior test, a pretest, post test, instructional text, work activities, checkpoints, and positive reinforcement.

The materials were reviewed for appropriate content and sequencing. The designer reviewed the materials for correct grammar, vocabulary, spelling, and clarity of instructions. Twenty five copies of activities 1 and 2 were made, and two complete packets were assembled. These completed packets were used during the formative evaluation stage.

CHAPTER 5

IMPLEMENTATION

Introduction

The goal of the instructional design states, "Given written directions and necessary materials, students will complete an activity in the science center. Students will work for 30 minutes without teacher direction." The instructor designed a science activity center where students will work on experiments and activities using a learning activity packet.

The plan was to design a series of learning activity packets with self-directed activities. The students work in small groups chosen by using the cooperative learning method of selection. The students had an opportunity to work in the center for one forty-minute period a week. The activities contained self checks at various stages of the activities, and were turned in to the teacher on completion for further review. The center will include learning activity packets on magnets, buoyancy, nutrition, digestion, and life cycles. Through use of the center, the students become more confident in their own abilities and realize that they are capable of completing activities without the instructor leading them step by step.

This chapter presents the information needed to implement the science activity center. It begins by describing the materials that were used for the implementation. The instructional delivery is also described in detail. The chapter concludes by explaining the means of data collection to be used for the evaluation.

Materials for Implementation Produced

The science activity center was set up in the corner of the classroom before the students were introduced to the idea of learning activity packets. The center consisted of a rug, a work table with chairs, shelves with materials, and posters and charts on the wall. Center materials included, but were not limited to, weights and scales, magnets, rocks and shells, corks, feathers, thermometers, plastic cups, aluminum foil, a box of odds-and-ends, and idea books.

The science center will have five learning activity packets corresponding to and supplementing the third grade science curriculum. All of the activities include exercises that are to be self checked by the student using answer keys. Other exercises must be checked by the teacher. This combination allows for students to take responsibility for their learning and self evaluation, while also providing the teacher an opportunity to evaluate students' work. The teacher was responsible for reviewing all work, and together with the student, a decision was made as to whether an activity must be repeated or whether the next activity may be done.

The teacher was responsible for keeping a master list of the students and the progress made by each. The students received a folder to record their progress as well. Stapled to the inside cover was a checklist naming each packet and its activities. Students checked-off the appropriate activity when completed, and answer packets were stored in the folder.

The learning activity packet Magnets was used for the implementation (Appendix G). The activities for the Magnets LAP included materials from two sources, Elementary Science-Learning by Investigating (1972), and Center Stuff for Nooks, Crannies, and Corners (1973). The learning activity packet consisted of an introduction and six activities. Each activity had a separate cover sheet listing the needed materials and vocabulary to be defined, consumable answer sheets (appendix H), and answer keys. The Magnets LAP included:

Introduction: The introduction explained the objectives to be met and the LAP contents. Students were asked to record their existing knowledge and ideas about magnets. They were also introduced to a variety of magnets and the proper names, including horseshoe, bar, U, miniature, rubber, and lodestone.

Activity One: The objective of activity one was for students to determine the types of materials that a magnet will pick up. Students were given ten objects to test and the answers were to be recorded. The objects included a plastic button, copper coin, rock, aluminum pan, paper clip, steel washer, pencil, nail, crayon, and chalk. This is a self check section. The students are then challenged to find five new objects that a magnet will pick up and five new objects that a magnet will not pick up. Answers were recorded for teacher evaluation.

Activity Two: The objective of activity two was for students to name and explain the properties of magnetic poles. Vocabulary included: attract, repel. Using bar magnets, students were asked to test the reactions of the magnets when placed in various positions. Observations were recorded and self checked. Students were then challenged to complete a worksheet without the use of the magnets. Pictoral sets of magnets are shown in several positions. Students must determine the reaction of the magnets. Answers were recorded for teacher evaluation.

Activity Three: The objective of activity three was for students to compare the strength of three different sized magnets, and determine the strongest point of a given magnet. Using three different sized magnets, the students counted the number of pins that each attracted. Students recorded their observations on a bar graph. Students then determined the strongest point of a horseshoe magnet. They recorded the number of pins attracted at each end of the magnet, and the middle. After recording the information the students deduced which was the strongest part. Students are challenged to do the same for a bar magnet.

Activity Four: The objective of activity four was for students to determine if there was a change in a magnet's strength when altered by various materials. Students charted the number of pins a magnet attracted through air, cardboard, water, cloth, glass, tin, plastic, and wood. The answers were recorded on a bar graph.

Activity Five: The objective of activity five was for students to make a magnet out of a non-magnetic nail. Students were instructed to rub a nail with a magnet for a given number of strokes. After the designated number of strokes, the students tried to pick up paper clips with the nail. The number of clips attracted was recorded. The students were then challenged to find three other objects that could be turned into magnets.

Activity Six: The objective of activity six was for students to state and explain everyday uses for magnets. The students were presented with a story that illustrated three uses for magnets: picking up spilled pins, removing metal from an eye, and keeping notes on a refrigerator. The students were challenged to find a minimum of three additional uses for magnets. Reference materials could be used to aid completion.

Instructional Delivery

The process used to deliver the instructional materials was comprised of lectures, demonstrations, and small group work. Although the definition of a LAP includes that it is self instructional, the needs of the target population dictated that teacher presentation be included.

After beginning the science curriculum with the class using the traditional classroom materials, the center was formally introduced as a place for independent and small group activities. The students were shown that for each unit of study there was a corresponding unit in the science center. A sample LAP was shown to the class and used by the students with each lesson. After a series of lessons, which will be described in detail, the students were able to answer the following questions:

1. What is a learning activity packet?
2. Where are the materials for the center located?
3. How do I complete a LAP?

At this time the entry-behavior test was given, and reviewed before instruction began.

The lessons that follow are generic. They introduce and teach the packet format, location of materials, and the process for completing a learning activity packet regardless of the unit of study.

Lesson 1: The first learning activity packet, Magnets, was displayed and identified. Students were provided with a copy of the the packet and a large mock up was displayed in front of the class. The teacher needed to explain that before an activity is started, the students must determine what is needed, and understand the steps to be followed. Student volunteers were called up to locate the list of materials needed, found on the mock up. All students were to find this on their own copy. Next the students were called to read through the activity sequentially. Each step was explained and reviewed. Students were shown how to fill in the answer sheets when indicated to do so in the packet. The teacher used a transparancy for a visual aid.

Lesson 2: To begin lesson 2, the main objective of the first lesson was reviewed: to identify the needed materials and understand the procedure before beginning an activity. Next, the materials in the center were located. It was explained that it is necessary to know where the needed materials can be found so that the student does not waste time, taking away from the time for working on the activity. The introduction to the Magnets LAP was displayed. Each student received a copy to use during the lesson. As a class, each needed material was read from the activity, located in the center, and retrieved to a table set up in front of the class. The teacher then demonstrated how to go through the list, checking for any materials that may have been forgotten. The teacher then led the class through the introduction, following the procedure step by step. The teacher called volunteers to read the directions and demonstrate in front of the class with teacher assistance. The students completed their own answer sheets while the teacher modelled this at the front of the class. At the completion of the activity, volunteers were called to place the materials back in the center properly. The main objectives were copied into notebooks to be used later as a reference, and a question/discussion session was held.

Lesson 3: Lesson 3 was started by volunteers recalling for the class what was done in lesson 2. The answers were listed on the chalkboard: locating materials, completing an activity sequentially, and cleaning up. It was explained that today the class would learn how to check the answers that were recorded during lesson 2. Using the answer sheets completed by the students, the answer key for those sheets was displayed. The location of the answer keys in the center was pointed out. The students were shown how to find the correct answer key in the packet. With the use of the overhead projector, the answer key was shown to the class. Students checked the results recorded on their sheets with those listed on the key. A question/ discussion session was held.

Lesson 4: The students were reminded that they had learned the steps for properly completing an activity in a LAP: locating materials, understanding the directions before beginning, completing the activity sequentially, and checking the answers where needed. Students were now placed in their center groups, predetermined by the teacher using the cooperative learning method of selection. Students then received a copy of activity one. The groups worked simultaneously, with teacher guidance, to complete the activity. The directions were read aloud by volunteers. Members from each group retrieved the materials. Each group working as one, had to complete the procedure. Each student filled in his or her own answer sheet. Discussion among group members was encouraged. When all the steps of the activity were completed, group results were compared, and then checked with the key. Students were shown how to check off the activity on their progress chart. The answer sheets were turned in to the teacher for evaluation. Questions were answered, reactions shared, and notes copied into notebooks.

Lesson 5: The teacher began lesson 5 by stating that the students had a chance yesterday to complete an activity from the science center and that they did an excellent job. The procedure was reviewed, students using their notebooks if necessary. The following questions were asked:

1. What is the first thing you do in an activity?
2. What is the next step ?
3. When you begin, does it matter what order you complete the activity?
4. When you are finished, what do you do?

Students were again put in their groups. It was explained that today each group was to complete activity two of the LAP. The group members were encouraged to assist each other in following the procedure. The teacher moved among the groups offering assistance where needed. The teacher began to slowly remove herself from the process. The instructor completed a group evaluation checklist at this time. When all groups were finished, results were compared and checked. Problems encountered were discussed, questions answered, and feelings shared. At this time the first attitude survey was completed by the students.

Lesson 6: A final lesson was presented to show students how to fill out a reaction sheet. A reaction sheet was to be filled out for each packet completed. This sheet was to be turned in with the answer packet, and discussed at the individual conferences.

The remainder of the activities, 3-6, were completed by the students when their group was scheduled to use the center. One group was then randomly selected to use the center for four consecutive days, as opposed to the one period a week. This group served as subjects for the small group evaluation. Other groups were scheduled for the center one period a week when the small group evaluation was completed. The groups were encouraged to follow these guidelines when working in the center:

1. Read the directions aloud 3 times when "stuck."
2. Ask your group members for help, and offer assistance when asked.
3. Ask the teacher if you cannot proceed after reminders 1 and 2.

As each group worked in the center, the teacher was evaluating the program and making needed changes.

It was vital that at the start of each new lesson that the previous lesson was reviewed. The plan of moving from whole class lessons, to group with teacher assisted lessons, to groups without teacher assistance was also essential. For the students to work independently of the teacher, they must feel confident and understand what is expected of them. By following this plan, the teacher was able to assess the capability of each student to work without the teacher, and the students were weaned off their dependency slowly, having time to adjust to the idea of working in the center.

Data Collection

Data was collected to be used in the summative evaluation. Data collected included the following:

1. Attitude surveys (appendix I)
2. Observations/Checklists (appendix J)

3. Student-teacher conferences
4. Post test (appendix F)

Summary

This chapter presented the information needed to develop and implement a science activity center to be used for independent learning. The chapter began with a description of how the center was physically set up. Next an explanation of the materials to be used in the center and during instruction was given, followed by a detailed description of the instructional delivery. The chapter concluded with the tools used for the evaluation process.

CHAPTER 6

EVALUATION

Introduction

A design that has been implemented must be evaluated to determine if it is effective. The instruments of data collection, which were described in the implementation chapter of this project, must be utilized. The results must be analyzed and interpreted to be meaningful.

In this chapter, the formative evaluation procedure will be presented. Included will be a description of the one-one-one evaluation, the small group evaluation, and the field trial evaluation. The results will be presented. Next the summative evaluation will be presented with the results to determine if learning was significant. The chapter concludes with a description of the learning transfer.

Formative Evaluation

Formative evaluation is the collection of data and information during the development of instruction which can be used to improve the effectiveness of the instruction (Dick and Carey, 1985). Using the data collected, revisions are made to the instruction and materials to produce an instructional program that is as effective as possible. There are three phases of the formative evaluation: one-on-one evaluation; small group evaluation; and field trials.

One-on-One Evaluation

A one-on-one evaluation was used to determine the readability of the activity packets, and whether the directions would be understood by all students in the target population. Three students with different reading abilities were chosen for the one-on-one evaluations. The characteristics of these students are summarized in table 6.

Table 6

Subjects for the One-on-One Evaluation

Subject	Age Years	IQ	SAT Scores Math	SAT Scores Reading	Other
1. male	9	143	99%	94%	participant in the gifted and talented program
2. female	9	111	64%	68%	
3. male	10	75	32%	40%	classified as speech and language impaired; resource room and speech services

Each student was given the Magnets learning activity packet and asked to read the activities as if to be performed. After reading each activity, the student was asked to paraphrase; to explain in the proper order what was to be done. Students were encouraged by the designer to question any parts that were unclear or not easily understood. As each activity was explained, the teacher used a rating scale of 1-3 to determine the ability of the student to understand the procedure, 1 being the most accurate, 3 the least accurate. The results achieved are shown in table 7.

Subject 1 was able to accurately describe all of the activities in the learning activity packet. All vocabulary was

Table 7

Student Ratings for the One-on-One Evaluation

Activity	Subject 1	Subject 2	Subject 3
Introduction	1	1	1
Activity 1	1	1	1
Activity 2	1	1	2
Activity 3	1	2	2
Activity 4	1	1	2
Activity 5	1	1	3
Activity 6	1	2	2

easily decoded and directions comprehended. Sequencing of steps within an activity also posed no problem.

Subject 2 was able to describe all of the activities accurately; however, she needed to refer back to some of the activities several times. Some of the vocabulary was not easily decoded, but this did not seem to interfere with the comprehension of what was to be done. Sequencing of steps was not a problem.

Subject 3 had more difficulty than the others in explaining what was to be done. Certain vocabulary had to be read by the teacher, including the words: substances, interfere, determine, and attraction. Part of his difficulty in paraphrasing could be attributed to his speech impediment, stuttering. Although he had difficulties, at no time did he appear to be frustrated.

After conducting the one-on-one evaluations, it was clear to the designer that the majority of the activities would be easily understood by all students in the target population. Although some were more difficult for subjects 2 and especially 3, at no time did the designer observe signs of frustration or discomfort. For the students who may have some difficulty, it is part of the instructional goal that these students will seek help from their group members.

The designer's decision at this point was to leave the activity packet as it was presented. However, in the center, a chart listing key terms and vocabulary found throughout the packet was added. This was to help eleviate any difficulties with terminology.

Small Group Evaluation

Before the small group evaluation was conducted, the class as a whole was instructed on how to use the science center and the process for completing a learning activity packet. Although it would have been more appropriate to only use the subjects for the small group for the instruction, the class as a whole had to participate due to time restraints for the implementation during the school day and year. During this instruction, the class was formed into five groups, five students per group. Using the scores from the SAT tests taken during second grade, the students were first categorized into groups: above average, average, and below average. The results are summarized below in table 8.

Students were then ranked from high to low, and the instructor formulated groups using the cooperative learning method of selection; selecting members by alternating from the top of the list and the bottom. Each group then worked together during the instruction, on activities one and two from the packet. The instructor observed the group dynamics and completed a checklist

Table 8

Number of Students Categorized
by SAT Scores

	Reading Comprehension	Math Concepts
Above Average	10	12
Average	8	7
Below Average	7	6

for the group evaluations.(See appendix J). Attitude surveys were also completed at the end of this instruction. (See appendix I).

One group was then randomly selected to be the first group to use the science center. Teacher input was provided only upon the request of the subjects working in the group. Instead of being scheduled for one period a week, the group was scheduled for one period a day to complete the learning activity packet within a week.

This group was the subject for the small group evaluation. The group members consisted of three males and two females. The characteristics of each member are listed in table 9.

Observations of the group working in the center were made, again using the group evaluation checklist. (See appendix J.) The checklist was completed on days one and four of student use of the center. The results are illustrated in table 10.

There were two changes that occurred from day one to day four: questions 3 and 8. On the first day there were only two copies of the Magnets learning activity packet. With all five

Table 9

Subjects for the Small Group Evaluation

Subject	Age Years	IQ	SAT Scores Reading Level Equivalent	SAT Scores Math	Other
1. male	9	142	6.4	99%	gifted and talented program
2. female	9	110	8.3	93%	
3. female	9	99	3.8	46%	
4. male	9	92	3.1	57%	
5. male	10	93	1.8	66%	resource room; LD

Table 10

Group Evaluation Checklist Results

Question	Day One	Day Four
1.	Y	Y
2.	Y	Y
3.	N	Y
4.	N	N
5.	N	N
6.	Y	Y
7.	Y	Y
8.	N	Y

students working on the same activity, it was difficult for the students to read the information. The students were willing to help each other; however, they became irritated when they could not proceed or go back to a particular section. The designer believed that this led to the students having little patience with one another as recorded in question 3. This was remedied by adding several copies of the learning activity packet to the center as well as adding to the number of some of the materials. With the students each having their own packets, they were more content in the center and more tolerant of, and helpful to, each other.

For question 8, on day one the noise level was not acceptable. The students working in the center were disrupting the other class members. The problem the designer observed was that every time a student needed to get new materials or leave the table, the folding chairs made quite a commotion. The noise of the metal chairs hitting against each other was rather loud, and twice, a student was folded inside of one because he would squat on the chair. This disturbance was removed by removing the chairs from the center. The students did not seem to mind that they had to stand at the table. The rug was still available for activities that could be carried out on the floor. Also adding to the high noise level on day one was the students arguing over use of the packets. As mentioned previously, copies of the packet were added so the students had their own.

Evaluations were also made of the individuals working within the group. Again a checklist was used and the results were recorded on days one and four. The individual student checklist is illustrated in appendix J. Using a scale of 1-4, each student was rated as to the degree in which each task was completed, 1 being the most accurate. The results are listed in table 11.

Table 11

Individual Student Evaluation Results

Question	Day One Subjects					Day Four Subjects				
	1	2	3	4	5	1	2	3	4	5
1.	2	2	3	4	4	1	1	1	2	2
2.	1	1	2	2	2	1	1	1	1	1
3.	2	2	2	4	4	2	1	1	2	2
4.	2	2	2	2	2	1	1	1	1	1
5.	1	1	1	1	1	1	1	1	1	1
6.	-	-	2	3	3	1	1	1	2	3
7.	2	2	3	3	3	1	1	2	2	2
8.	3	2	1	2	1	2	1	1	1	1
9.	1	1	1	1	1	1	1	1	1	1
10.	1	1	2	1	2	1	1	1	1	1
11.	1	1	2	2	4	1	1	1	1	2

On day one, all subjects had some degree of difficulty finding the correct activity. For most of them the problem seemed to be forgetting to refer to their check-off sheet to see which was the last activity completed. Students had no or very little trouble in locating their answer folders. Some of the folders were not placed alphabetically and sorting was necessary. On item three, two subjects did not read the directions at all before beginning. The other three subjects appeared to be racing. The designer attributed a small amount of this to the excitement of using the center for the first time.

There was a slight delay in locating the needed materials. The students all went to the proper shelves; however, a few of the materials were difficult to see. All of the students completed the activity sequentially, much to the designers surprise! The three students who could have used help did not readily ask their group members. Subject 3 did so very cautiously, looking toward the instructor for approval. Only then did subjects 4 and 5 seek help, mostly out of a desire to continue. Students often neglected to record part of their answers, as reflected in question 7. Students often caught the mistake as they went to record another answer. Where completed, it was done so correctly.

Not surprisingly to the designer, cleanup was not very carefully done. Two of the students "stuck" things away, and only two students returned everything to the proper place where they were taken from. All students returned their answer folders to the proper place to be reviewed by the teacher, and all students marked off their check-off sheet. Two students did have to be reminded of this by other group members.

Two of the students were able to work in the center for the entire period without the teacher. Two students approached the teacher one time each, and subject 5 had a difficult time not wanting to share what was happening with the teacher.

The findings for day four show improvements across the board. Although all of the ratings were not a perfect 1, all subjects showed an increase in accuracy when using the center.

To determine if the changes that occurred in behavior and accuracy while using the center were significant, a t-test was computed. The results are shown in table 12.

Table 12

T-test for Individual Evaluations

Subject	X1	X2	D	D
1	16	13	3	9
2	15	11	4	16
3	21	12	9	81
4	25	15	10	100
5	27	17	10	100
	EX1 104	EX2 68	ED 36	ED 306
	X1 20.8	X2 13.6	D 7.2	(ED) 1296

$$T= \frac{7.2}{\dfrac{306-\dfrac{1296}{5}}{5(5-1)}} = \frac{7.2}{\dfrac{306-259.2}{20}} = \frac{7.2}{\dfrac{46.8}{20}} = \frac{7.2}{2.34} = \frac{7.2}{1.53} = 4.71$$

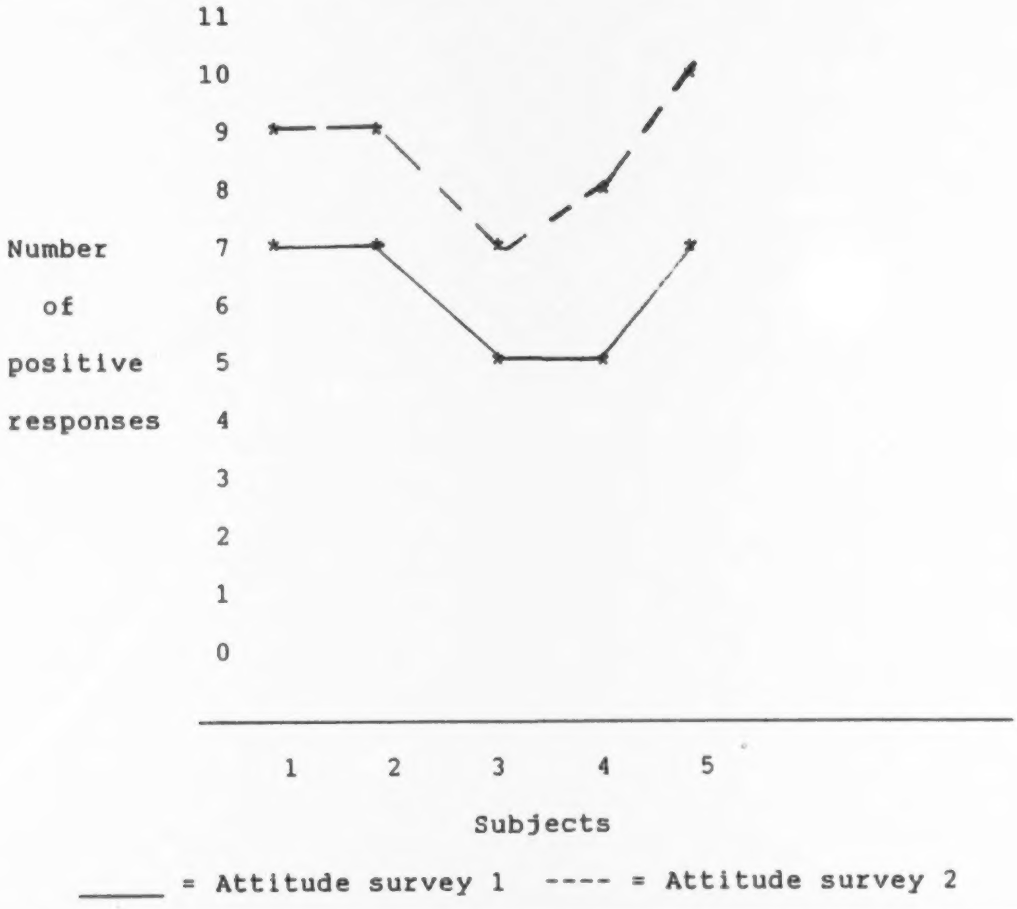
The scores for day one served as a pretest and the scores for day four served as the post test. This test determined if repeated use of the activities has had an effect on a student's ability to work without teacher direction. To arrive at one score for each student, the rating for each question was added. These sums were used as the test scores. When the value of 4.71 was tested at the .05 level for a one tailed test, with a df of 4, the learning that took place was significant. The value at the .05 level is 2.132 which the above value for t clearly surpasses.

An attiutude survey was given to the small group subjects at the completion of the learning activity packet. (See appendix I.) These results were compared to the results of the survey taken before using the center. The comparison showed any change in attitude about using the center or working in a group. The results are summarized in figure 1.

The graph illustrates that there was an increase in positive attitudes towards using the center and working with peers.

Figure 1

Comparison of Attitude Surveys for Small Group



Although each student did not give a positive response for each and every item, improvement was seen among all of the students.

At the end of the small group evaluation, several changes were made. As mentioned previously, copies of the learning activity packet were added to the center, along with more of each kind of material. Chairs were eliminated to help reduce the amount of noise coming from the center. Additional changes included rearrangement of the materials on the shelves and more easily read labels.

The activities themselves did not hinder the performance of the group. The difficulties seemed to have more to do with the physical set up of the center. After conferencing with the students, it was realized that the diversity of the students within a group needed to be more sufficiently utilized. Low achievers would be matched with a higher achieving student to reduce the hesitancy of asking peers for help. High achievers were also assigned as group leaders, trouble-shooting problems that arise, and overseeing the other members. These students may also be challenged to design a new activity for the center. In this way, each student will be using the center to meet his or her own needs.

Field Trials

Due to the number of students and time available during the implementation process, a true field trial was not conducted. The materials were implemented with the remaining groups with evaluations being made on a continual basis. Due to the design of the instructional program, that students will work in small groups, the field trials/implementation was really a repetition of the process decribed during the small group evaluation. The purposes of the field trial/implementation are to determine if the changes made during the small group evaluation were effective, and deciding if the instruction can be used in the environment for which it was intended. Each of the remaining four groups was scheduled to work in the center for one forty-minute period a week. Each group was observed and evaluated for group dynamics, individual performance and behaviors.

The designer tried to simulate the environment as close as possible to the actual instructional situation. Ideally the teacher should be working with other students while the groups worked in the center. Because observations were necessary, the teacher could not do this, but did physically separate as much as possible from the group working in the center.

Observations of the groups revealed problems in the beginning. When the teacher was "out of sight," there was less cooperation among the students. Several students who were the cause of the disruptions were reprimanded by the other group members, and this peer criticism seemed to eleviate most of the problems. The results of the group evaluation, appendix J, are summarized below for groups 2-5 in table 13.

By day four all groups had worked out the major differences among the members. Although every group did not receive a perfect rating, all groups were productive and remained the same.

The groups were also observed for individual performance in the center. The results are listed in appendix J. None of the students seemed to have the difficulties noted during the small group evaluation. This helped to ensure the designer that the revisions that were made were effective. At this point the instruction and materials appeared to be effective for the target population.

Table 13

Group Evaluation Results

Field Trial/Implementation

	Day One								Day Four							
Question	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Group 2	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
Group 3	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Group 4	Y	N	N	N	Y	N	N	N	Y	Y	Y	N	N	Y	Y	Y
Group 5	Y	N	N	Y	N	N	N	N	Y	Y	Y	N	N	Y	Y	Y

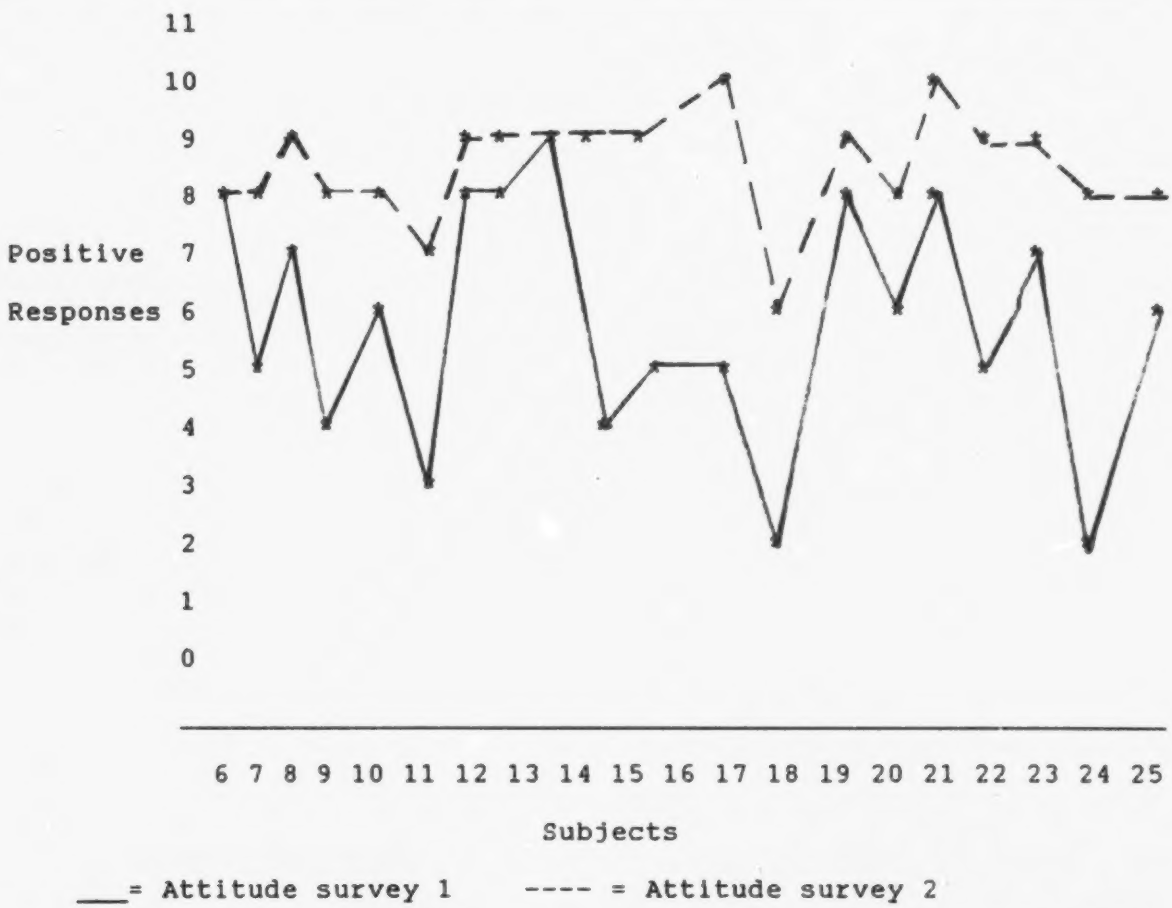
At the completion of the learning activity packet, each student completed the second attitude survey. (See appendix I.) This was used to see if attitudes had changed; were students eager to continue work in the center or apprehensive. The results are listed in appendix J. To determine whether attitudes of the students were affected by working in the center, the data had to be made more measurable. For each positive response that a student gave, one point was given. A student with all positive responses would receive a score of 10. The results of both attitude surveys are compared below in figure 2.

After using the activities in the center, the attitudes expressed by the students were more positive than before they used the center. The results are in harmony with those tabulated during the small group evaluation. The findings illustrate that students were more at ease with the idea of independent group work and had more confidence in themselves and their peers to work without the teacher.

Figure 2

Comparison of Attitude Surveys

Field Trial/Implementation



A post test was given to all students at the completion of the Magnets learning activity packet. The objective of this test was to determine if the students knew the procedure for completing a learning activity packet. It also recalled the steps of action to take before seeking help from the teacher. The post test and the results are included in appendix F.

The results show that the students have internalized the procedures with the exception of five instances. The errors that were made would not have affected the results of the activity;

however, they were corrected and reviewed.

Finally, conferences were held with each student upon completion of the learning activity packet. Although the average conference only lasted between 7-9 minutes, it provided a great deal of insight. Third graders tend to elaborate on their ideas and reactions when they do not have to be written down. The dialogue allowed the instructor to hear and see the emotions of each student, which is almost impossible from the writing on a piece of paper. Questions discussed included:

1. What was your favorite part about working in the center?
2. What was your favorite activity? Why?
3. What part did you enjoy the least? Why?
4. Did you find the activities easy to work on?
5. Would you want to work in the center on new activity packets?

To summarize, the students all expressed that they enjoyed working in the center, although some students had reservations in the beginning. There was no particular activity that stood out as a favorite or a most disliked. The part of the procedure that the students stated as the least likeable was checking their answers. Most suggested that when they were finished, the teacher should mark the activities for accuracy. Students were used to this procedure and were lacking the discipline at first to sit and complete the check carefully. The students seemed more interested in previewing the next activity. The students all loved getting stickers on the progress chart as each activity was completed. Students proudly talked about their certificates of completion.

Summative Evaluation

To make a determination as to whether the instruction and materials designed were effective, a Summative Evaluation must be conducted. The summative evaluation is the collection and interpretation of data for a specific instruction for the purpose of determining the value for a defined population (Dick and Carey, 1985). Following the procedure of Kirkpatrick (1987), four levels of evaluation should be included: reaction, learning, behavior, and results.

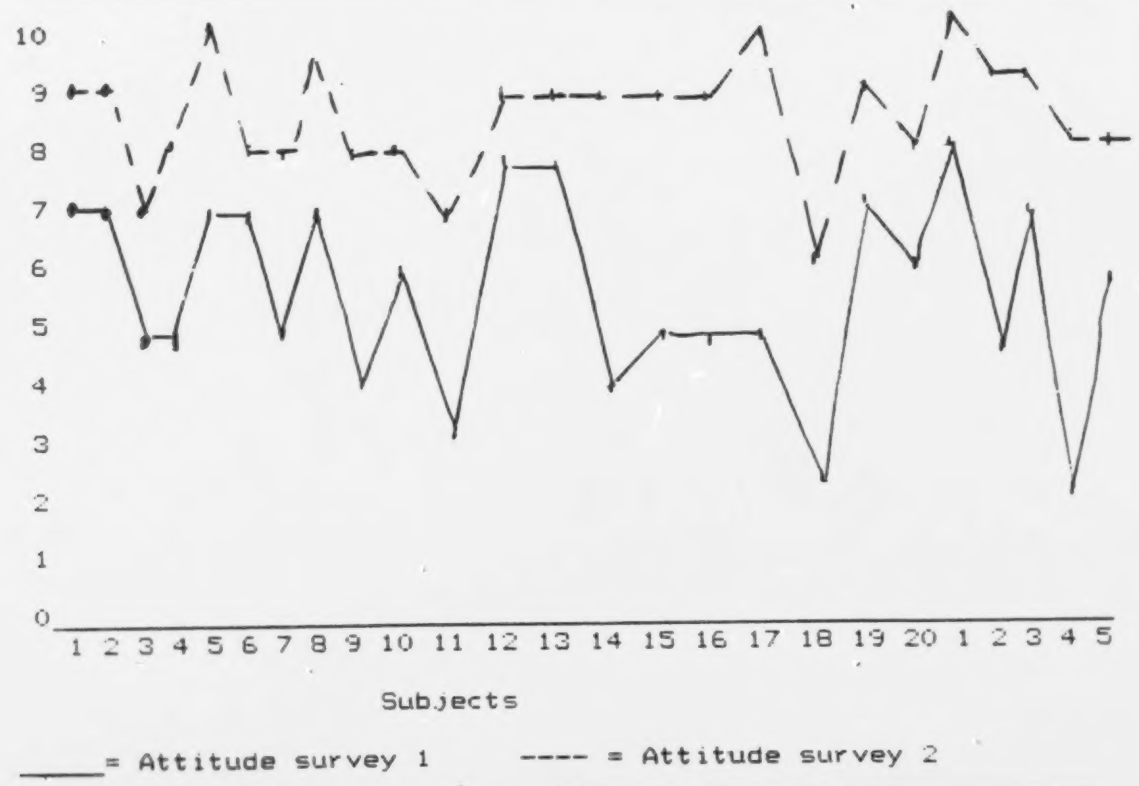
Reaction

The reaction level answers the question, "Were the participants pleased with the instruction and the activities?" (Kirkpatrick, 1987). Two means of evaluation were used here: the attitude surveys and conferences.

The attitude surveys revealed the results listed in appendix I. A comparison of these results is made in figure 3.

Figure 3

Attitude Survey Comparisons



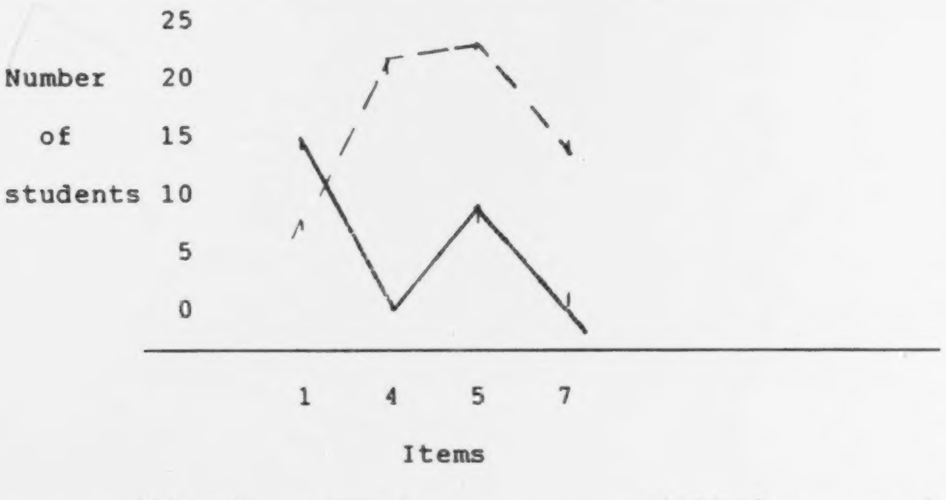
The figure shows the number of positive responses given before using the center and after using the center. This group of scores represents the class as a whole. One can see that the students felt more positively about working in the center without teacher direction after the experience of the center. There are four questions which should be analyzed separately from the rest of the survey: questions 1, 4, 5, and 7. These items focus directly on the students' attitudes about working without the teacher. The items are:

1. I like to work by myself.
2. I enjoy working in small groups.
3. I need my teacher telling me what to do in order to complete my work.
4. I do not feel good about asking my classmates for help.

A graph was produced to see if any significant changes occurred. The comparison of student attitudes before and after work in the center, is shown in figure 4.

Figure 4

Attitude Survey-Items 1, 4, 5, 7



Question one was of concern to the designer due to the decrease in positive answers. Through the conferences it was shown that the students did not like to work by themselves, but preferred working in the small groups. The increases seen in questions 4, 5, and 7 were in response to working with peers, asking for help, and being confident without the teacher.

The conferences held with the students were a good measure of students' reactions. All students expressed that they enjoyed the activities and were looking forward to starting the next LAP. Motivation was high among all groups, even those who were apprehensive at the onset of the center participation.

Learning

The learning level answers the question, "Did the participants learn from this instruction?" (Kirkpatrick, 1987). Three means of evaluation were used to determine if learning took place: individual observations, post test, and answer sheets for the activities.

The test for individual learning was a checklist. Each student was rated using a scale of 1-4 as to the degree of accuracy that the procedure was followed, 1 being the most accurate. The results for the class are summarized in appendix J.

To see if the changes that occurred were considered significant, a t-test was computed using the same procedure that was described in the small group evaluation in the formative evaluation section of this chapter. The results for the class are computed in table 14.

When tested at the .05 level of significance for a one-tailed test and a df of 24, the critical value of t equals 1.711. The value found clearly exceeds the critical value.

Table 14

T-test for Individual Learning

Subject	X1	X2	D	D
1	16	13	3	9
2	15	11	4	16
3	21	12	9	81
4	25	15	10	100
5	27	17	10	100
6	20	14	6	36
7	23	17	6	36
8	22	12	10	100
9	24	12	12	144
10	20	12	8	64
11	22	13	9	81
12	22	14	8	64
13	20	16	4	16
14	21	13	8	64
15	21	13	8	64
16	25	15	10	100
17	23	15	8	64
18	28	17	11	121
19	21	13	8	64
20	21	12	9	81
21	24	15	9	81
22	24	14	10	100
23	22	15	7	49
24	22	12	10	100
25	22	11	11	121

EX1=551 EX2=343 ED=208 ED=1856

X1=22.04 X2=13.72 D=8.32 (ED)=43,264

T = 8.32 8.32 8.32 8.32 8.32

1856-43264

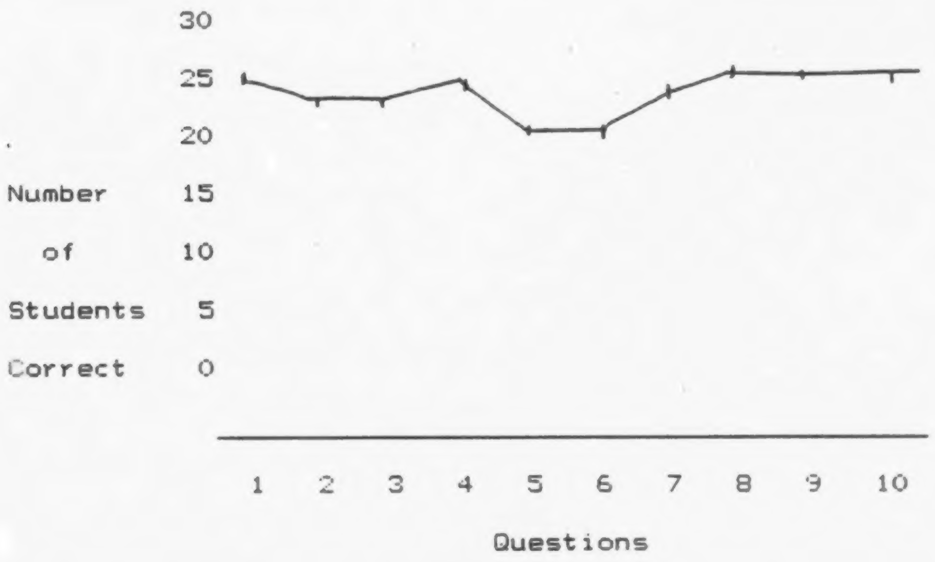
25 = 1856-1730.56 = 125.44 = .209 = .457 = 18.19

25(25-1) 600 600

The post test was designed to evaluate whether the students had learned the procedure for completing an independent learning activity. The results of the post test, which are included in appendix F, are graphed below in figure 5.

Figure 5

Post Test Results



This graph shows that the large majority of the students were able to recall the procedure properly without error. There was a total of 10 misses out of a possible 250. This computes to a 96% success rate for the class as a whole.

The final measure of learning was the record kept by the instructor as to how correct the answers turned in were. The progress that each student made was an indication for what was being learned. If a student did not get a certain percentage of the answers correct, the student may not proceed to the next activity. Given the nature of the activities, if the procedure is followed correctly, the students should be successful. The number of errors made is an indicator as to whether the students had internalized the procedure, or whether the materials were effective.

Behavior

The behavior level answers the question, "Did the students change their behavior based on what was learned?" (Kirkpatrick, 1987). The evaluations used were the checklist for group evaluations and observations.

The checklist for the group evaluation for all subjects in the target population are found in appendix J. After the results for the entire class were charted, the results were compared to see if the changes in behavior from day one to day four were significant. For each question, the responses for groups 1-5 were added; first the positive responses and then the negative responses. A chi-square was used to measure the change in frequencies. The results are shown in table 15.

Table 15

Chi-square: Group Evaluation

	Day One	Day Four
Positive	21	39
Negative	19	1

$$X= \frac{80(/21-741/-40/2)}{(60)(20)(40)(40)} = \frac{80(720-40)}{1,920,000} = \frac{80(462,400)}{1,920,000} = \frac{36,992,000}{1,920,000} =19.26$$

At the .05 level with a df of 1, the results are significant if chi-square is calculated at greater than 3.84. The results of 19.26 clearly surpasses the critical value showing that learning was significant.

Observations were also an important means of evaluating behavior. The teacher saw changes not only in the way students worked and behaved in the center, but during other class activities as well. The students often checked the schedule to see when they would next use the center, and often watched as others were at work on the learning packet. After completion of the implementation, students were more willing to work without the teacher, were more resourceful in finding needed information, and were more willing to help and be helped by peers.

Results

The results level answers the question, "Did the changes in behavior positively effect my class?" (Kirkpatrick, 1987). The answer to this can only be determined by an on-going evaluation. The designer noticed immediate changes in the classroom, including more independent learning, more time to work with individuals, and better cooperation among students. Whether these changes will be permanent will only be known after further evaluation; a long term study must be done.

As stated above, the students were more enthusiastic and appeared more confident about working without constant teacher direction. Because of this, more activities were set up in the room for the students to use. Even without direction, the students willingly tried to complete the different activities. Because of these changes, the designer was able to work with students without the interruptions there were previously. This enabled each student in the class to receive more individualized attention.

The trend was a positive one. The center and the activities seem to be practical, enjoyable, learning experiences. The students have learned a procedure which they are carrying to various activities in the classroom. Most importantly, the students are exploring new topics and activities on their own.

Learning Transfer

Once students have acquired new skills, they must be able to transfer this learning to new situations. According to Broad (1988), there are several steps a designer/instructor can take to ensure transfer of learning. Some of these steps include:

1. Immediately assign students to projects which require transfer of new knowledge and skills.
2. Give immediate positive reinforcement to each student who demonstrates transfer of new skills to a task.
3. Encourage meetings of the students to share ideas, solve problems, and reinforce each other's transfer of new skills.
4. Have occasional practice sessions for important but little-used skills.
5. Temporarily reduce pressure on students and give extra attention and support for a period of time after the instruction.
6. Include new skills in the students' performance standards.
7. Remind students that change is challenging and difficult, but necessary.

Even with these reinforcements of the instruction, it is important to realize that lapses will occur. The best way to ensure that the students develop and increase their skills for independent learning, is to provide them with opportunities to use and practice the learned skills. As procedures and the process become more familiar, the students will become more confident independent learners.

Summary

This chapter presented the details of data collection and the results of the evaluations conducted. It started with the formative evaluations which included the one-on-one, small group, and field trial. The data for each section was presented and analyzed. Next the summative evaluation was presented. This described the overall effectiveness of the design and the materials implemented. Four levels of evaluation were studied: reaction, learning, behavior, and results. The chapter concluded with measures for helping to ensure transfer of learning to new and different situations.

CHAPTER 7

SUMMARY AND RECOMMENDATIONS

Introduction

This chapter provides a summary of the instructional project which was presented in this document. In chapter 1, the designer explained what was expected to occur during the steps of Insructional Systems Design. This chapter explains what actually occurred. The chapter concludes with recommendations that may benefit others who may want to use this work with another population, and for other designers who may want to create their own learning activity packets based on the results of this insrtuctional program.

Methods and Procedures Used

The method used for the instructional project was based on the Instructional Systems Design Model (ISD). This model has five stages of design and development. The five stages used were: analysis, design, development, implementation, and evaluation.

Analysis

The analysis stage included three steps, a needs analysis, a job task analysis, and a learner analysis. The instructional need was based on the designer's observations that third grade students were not applying, or lacking, skills for independent work. Not only did this limit the variety of activities that the students could work on, it limited the time the instructor had for individualized teaching. The need for new instructional materials was supported by the lack of appropriate existing learning materials. The target population was a heterogeneous, third grade class. The class consisted of twenty five students, ages 8-10 years.

Printed materials with the use of physical objects were the media chosen for the instructional project. The designer created a learning activity packet to be used in a science center. The packet contained activities that were to be completed in a small group setting, without teacher assistance. The instructional goal of completing an independent learning activity was divided into five main tasks and one affective task. These main tasks were then divided further into the steps needed to complete the given task. The designer researched existing literature and materials on independent learning activities and analyzed its appropriateness for the target population.

The designer developed a major events list and time line at the beginning of the project. The starting date was October 13, 1988 and ended on May 12, 1989. PERT and Gantt charts were used to diminish any conflicts and delays.

The design stage concluded with the development of an estimated budget. The projected costs of implementing the instructional program appeared high, but many of the costs were start up costs, to be incurred only once. The budget was within reasonable limits.

Design

During the design stage the designer identified six instructional objectives that paralleled the six main tasks. Objectives were also witten for the subskills for each of the tasks. These objectives were then grouped and sequenced into lessons for the instruction, following the process needed for completing and independent learning activity. Entry behaviors were identified, and objectives written in case instruction was necessary for some of the target population.

Following Gagne's nine internal learning processes and including method and media, a lesson plan was formulated. Six lessons, averaging fifty minutes each was an accurate prediction. Seven periods for work in the center was also an accurate estimate. During the design stage, evaluation materials were developed. These included an entry-behavior test, a pretest, progress checks, and a post test. Attitude surveys and reactions sheets were also planned. A direction check sheet was planned, but was determined to be unnecessary and not used. A reaction sheet was planned at the end of each activity, but was used instead at the completion of the packet, to eliminate some of the paperwork that the students had to keep track of. The designer used both the formative and summative evaluations. During the formative evaluation, the field trials were adapted to meet the time restraints of completing the implementation.

Development

The development of the learning activity packet was based on Vinskey's (1979) checklist for individualizing instruction. After the first draft of the packet was completed, it was reviewed with other teachers to test for appropriateness of content, interest level, and clarity of directions. One suggestion regarding the packet's durability was offerred and incorporated into the LAP.

The pretest, post test, and post-learning questionairres were produced. Positive reinforcements were included in the LAP, including a certificate of completion.

The entire packet was reviewed for accuracy of content and materials, and the center was checked to ensure that all needed materials were included. Twenty five copies of activities one and two were produced, as well as two completed packets.

Implementation

At the conclusion of the development stage, the formative evaluation was conducted. As a result of this evaluation, the materials were evaluated and revised. Originally, two packets were produced for the evaluation. This was not sufficient and three additional packets were added. Learners then used the revised materials during the implementation process. Evaluations were made on a continual basis.

Implementation of the learning activity packet differed from a traditional LAP which are designed for total independent use. Some of the activities were completed during class instruction, with the assistance of the insructor. This learning activity packet was a combination of class work, small group work, and independent work. During this stage the data for the summative evaluation was collected.

Evaluation

During the development stage, formative evaluation had been conducted. The designer utilized one-on-one evaluations, small groups evaluations, and adapted field trials. Problems with the activities and the set up of the center were noted and revised. The test results were also recorded and analyzed.

Summative evaluation included Kirkpatrick's four levels: reaction, learnng, behavior, and results. The designer needed to determine whether the instruction was enjoyable to the students, if significant learning had occurred, and the whether the instructional materials were valuable and should be continued to be used.

After analysis of the evaluation materials, the designer determined that the reliability and validity measures of the instructional program had been met.

Conclusions

The evaluation of the implementation stage and the attitude surveys, led the designer to conclude that the learning activity packet must be a combination of class and individual activity. Because the students had not used a learning activity packet previously and many were hesitant about working without the teacher, this instruction was necessary. However, some of the students did not require all of the teacher led instruction that was provided. After a simple, one lesson explanation, many students would have been able to work in the center without any major problems. Because the students were put into groups, with students of varying abilities, there is no way to avoid this problem, unless the extended instruction is given to those who need it, and then the groups are formulated. This, however, takes away the opportunity for the teacher to evaluate the group dynamics. This is an area that still needs to be considered.

Upon completion of the learning activity packet, all students were proud of their accomplishments and showed excitement about the prospect of working in the center again. There was increased cooperation among students and more tolerance for one another. There was also a higher level of motivation during the traditional science lessons in class.

The designer was pleased that the test results supported her observations: that significant learning and changes in behavior had occurred. Students applied these newly learned skills to other areas right away. The instructor was able to set up a variety of independent activities and research assignments. The students demonstrated increased persistence and did so with limited teacher assistance. This provided the instructor with more time to spend helping each student where needed.

Recommendations

1. The designer suggests the combination of teacher activities, small group activities, and independent activities during the instruction of the program. Careful preparation of the students before using the center helps to eliminate unnecessary questioning and eleviates much of the student's anxieties. Because of the time put in to the instruction before letting students work in the center, the process ran smoothly and the results found were achieved. Time invested in the beginning pays off two-fold in the end.

2. The designer originally intended for the students to be scheduled to use the center on a daily basis. Because of time constraints, students were scheduled on a weekly basis instead. This worked out to be a benefit. When students worked in the center once a week, they used the time wisely, knowing it would be a whole other week before they came back. It also provided the instructor time to evaluate the students' completed work.

3. The designer suggests producing the learning activies on stiff, durable paper, preferrably laminated. Wear and tear on the materials is greater than this designer expected. Have extra materials on hand; losses do occur. Avoid any materials which can be dangerous if broken or used incorrectly.

4. It is essential that positive reinforcements are provided throughout the instructional program. Students constantly were counting the stickers on their progress chart and displaying their

certificate. Teacher praise must be given often, but only when appropriate. The positive reinforcements keep the students motivated and their spirits high.

5. The designer recommends that learning activity packets be incorporated into classroom use whenever possible. The active learning was observed to be more enjoyable to the students and the increase in independent work decreased the amount of "busy work" that was completed in class. It also provided the teacher with more available time within the day to work with individuals.

Concluding Statement

The instructional program described in this document took a considerable amount of time and effort to complete. The development and implementation were especially time consuming. The work and effort that the designer invested in this project was a tremendous demand, and required a great deal of dedication and organization. The designer often questioned whether this investment of herself was worth it. The answer, now that the project is completed, it a definite yes!

The outcome of this project was more than the designer had anticipated. Not only did it increase the amount of time that the instructor had to work with individuals in the classroom, but it put a new light on learning in the eyes of the students. The children were motivated, eager, and hard working during the times they spent in the science center. They more willingly tried new activities and were more patient in their endeavors.

The use of a learning activity packet was an important part of these results. Students were able to work at their own pace, were able to refer to the materials when needed, and received positive reinforcements throughout the packet. This coupled with the use of hands-on activities created a learning experience that was successful for all students. The designer feels that this approach can be used with all ages and levels of ability. All students learn more when they are active participants as opposed to passive learners.

What is interesting to the designer is that students learn rules and procedures all the time while they are in school. The fears about working without the teacher did not stem from a lack of understanding about what to do, but rather from a lack of confidence that the student was capable to do it. But use of the learning activitiy packet in the science center had a different effect on the students. They were taught to believe in themselves; they were trusted to do something; they were believed in; and they were given opportunities to try something new and for it to be all right to make mistakes and try again. Perhaps our current system of education teaches students that the teacher has the right answers, that they need us to know what to do, and that children should be seen and not heard. These students learned that they were capable of making decisions, of following directions, and of thinking for themselves. When they began to believe it, wonderful things started to happen.

APPENDIX A

TASK ANALYSIS

COMPLETING AN INDEPENDENT LEARNING ACTIVITY

1.0 Describe the activity topic and identifty the steps necessary for completion

1.1 Locate the activity

1.2 Read the overview section of the activity

1.3 Write the heading on the response sheet

1.4 Read the directions sequentially

1.5 Complete a direction check sheet

1.6 Check answers to the direction check worksheet

2.0 Set up needed materials and equipment

2.1 Locate needed materials in the science center

2.2 Retrieve needed materials and place onthe work table

3.0 Perform the needed steps for completion of the activity

3.1 Sequentially complete each step in the procedure

3.2 Record findings on the response sheets

4.0 Check results for accuracy

4.1 Locate the answer key

4.2 Read the findings in the answer key

4.3 Compare and contrast the new data to that on the answer key

5.0 Complete a reaction sheet

5.1 Locate a reaction sheet

5.2 Complete the reaction sheet

5.3 Staple the reaction sheet to the answer sheets and place in the completed activities box

6.0 Students will show confidence when working independently

6.1 Students will smile and help peers

6.2 Students will demonstrate comfort

6.3 Students will seek less teacher assistance

6.4 Students will begin activity without hesitation

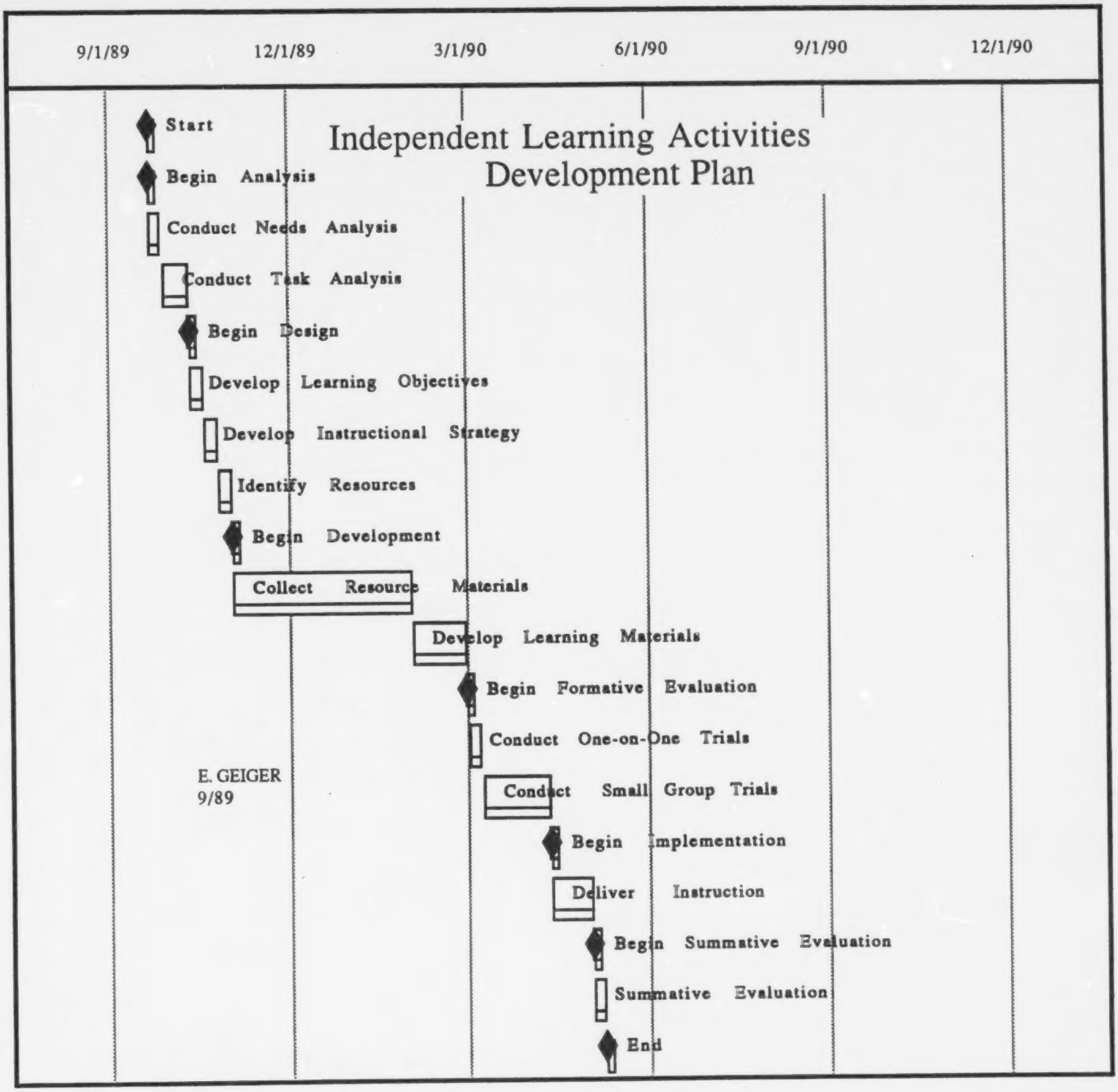
6.5 Students will apply skills to new areas

APPENDIX B

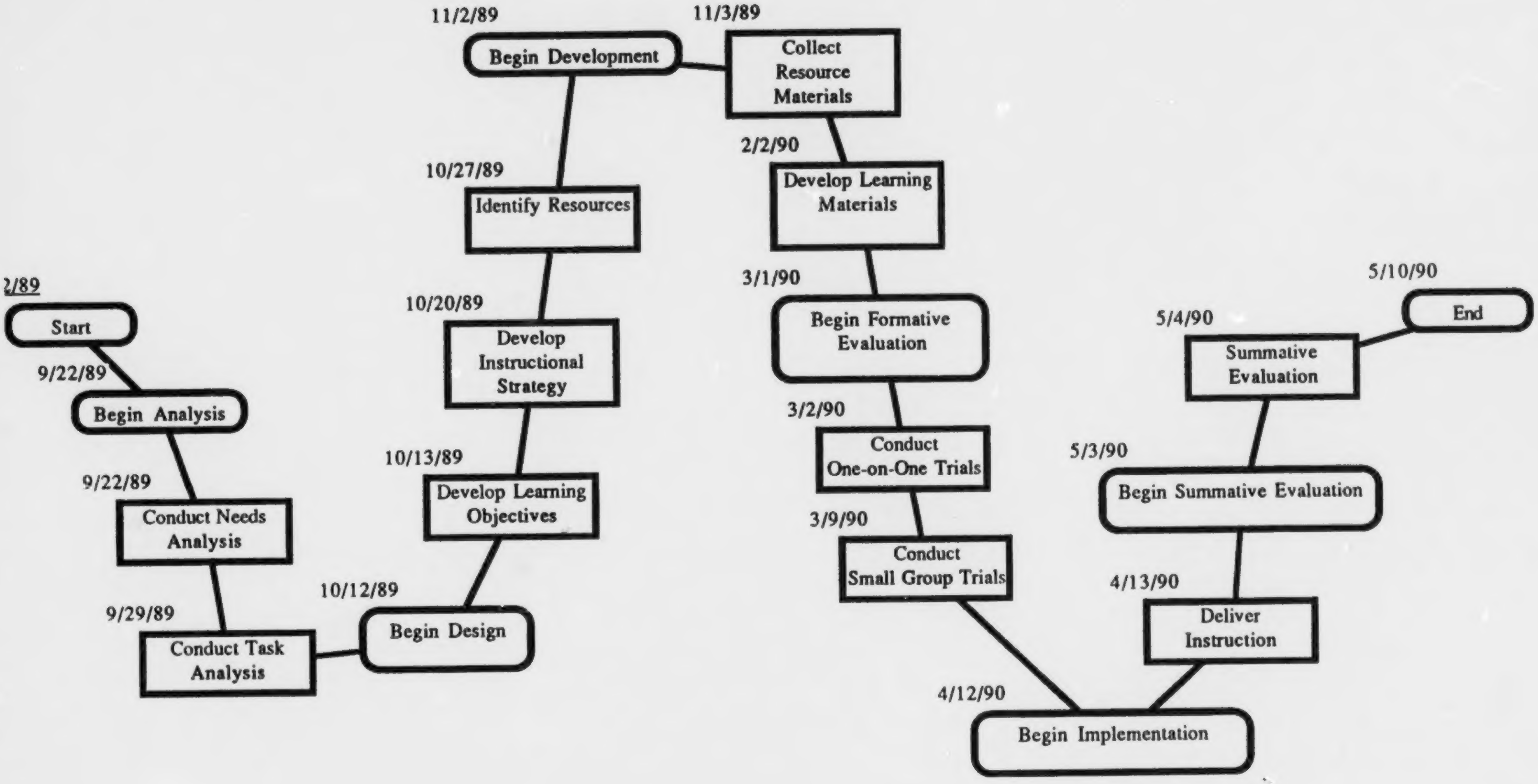
PROJECT PLANNING

MAJOR EVENTS LIST AND TIME LINE

	WEEKS	START	FINISH
1. Start	0	9/22/89	------
2. Needs assessment	1	9/22/89	9/29/89
3. Task analysis	2	9/29/89	10/13/89
4. Program design	3	10/13/89	11/03/89
5. Collect resource materials	2	11/03/89	11/17/89
6. Develop learning materials	3	2/04/90	2/25/90
7. Conduct one-on-one trials	1	3/04/90	3/11/90
8. Conduct small group trial	3	3/11/90	4/01/90
9. Formative evaluation	1	4/01/90	4/08/90
10. Revise materials	1	4/08/90	4/15/90
11. Implementation	3	4/15/90	5/06/90
12. Summative evaluation	1	5/06/90	5/13/90
13. End	0	-------	5/13/90


9/1/89
12/1/89
3/1/90
6/1/90
9/1/90
12/1/90
Independent Learning Activities
Development Plan
Start
Begin Analysis
Conduct Needs Analysis
Conduct Task Analysis
Begin Design
Develop Learning Objectives
Develop Instructional Strategy
Identify Resources
Begin Development
Collect Resource Materials
Develop Learning Materials
Begin Formative Evaluation
Conduct One-on-One Trials
Conduct Small Group Trials
Begin Implementation
Deliver Instruction
Begin Summative Evaluation
Summative Evaluation
End
E. GEIGER
9/89

Independent Learning Activities
Development Plan



2/89
Start

9/22/89
Begin Analysis

9/22/89
Conduct Needs Analysis

9/29/89
Conduct Task Analysis

10/12/89
Begin Design

10/13/89
Develop Learning Objectives

10/20/89
Develop Instructional Strategy

10/27/89
Identify Resources

11/2/89
Begin Development

11/3/89
Collect Resource Materials

2/2/90
Develop Learning Materials

3/1/90
Begin Formative Evaluation

3/2/90
Conduct One-on-One Trials

3/9/90
Conduct Small Group Trials

4/12/90
Begin Implementation

4/13/90
Deliver Instruction

5/3/90
Begin Summative Evaluation

5/4/90
Summative Evaluation

5/10/90
End

E. Geiger
9/89

APPENDIX C

OBJECTIVES: CLUSTERED AND SEQUENCED

OBJECTIVES;SEQUENCED AND CLUSTERED INTO LESSONS

LESSON	OBJECTIVES	TIME
1	1.1	50 minutes
	1.2	
	1.3	
	1.4	
	1.5	
	1.6	
2	2.1	60 minutes
	2.2	
	3.1	
	3.2	
3	4.1	40 minutes
	4.2	
	4.3	
	4.4	
	4.5	
4	1.1	60 minutes
	1.2	
	1.3	
	1.4	
	1.5	
	1.6	
	2.1	
	2.2	
	3.1	
	3.2	
	4.1	
	4.2	
	4.3	
	4.4	
	4.5	
5	1.1	40 minutes
	1.2	
	1.3	
	1.4	
	1.5	
	1.6	
	2.1	
	2.2	
	3.1	
	3.2	
	4.1	
	4.2	
	4.3	
	4.4	
	4.5	

6	5.1 5.2 5.3	30 minutes

APPENDIX D

ENTRY BEHAVIOR TEST

ENTRY BEHAVIOR TEST

NAME	Magnets	Corks	Pins/Nails	Feathers	Weights Scales	Aluminum	Steel Washers	Box of Objects	String/Yarn	Rocks/Shells		
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												
11.												
12.												
13.												
14.												
15.												
16.												
17.												
18.												
19.												
20.												
21.												
22.												
23.												
24.												
25.												

APPENDIX E

PRETEST

It is important to follow directions. Complete this activity.

REMEMBER-
FOLLOW THE DIRECTIONS!

THIS ACTIVITY IS ABOUT FOLLOWING DIRECTIONS. THERE ARE 10 DIRECTIONS TO READ, UNDERSTAND, AND FOLLOW. MAKE SURE YOU START WITH THE FIRST DIRECTION.

1. Read all of the directions before starting.

2. Add 2 + 4 + 5 + 9 + 7. ______

3. What are the first 5 words to the pledge of allegience?

   ____

4. What three things do plants need to live?

   ___________ _____________ ____________

5. Subtract 24 - 5 - 7 - 3 - 4. ________

6. List three words that have almost the same meaning as "fast".

   ___________ ___________ ___________

7. What number president was Abraham Lincoln? ______

8. Multiply 3 x 5 x 2 x 0. ______

9. Name the 7 continents. ___________ ___________ ___________

   _____________ ____________ ______________ ________________

10. Only do direction 1. Ignore directins 2-9!

APPENDIX F

POST TEST

Name

This test is to see
if you remember
what to do when
working on a
learning packet.

Read carefully and
check your answers.

PLACE THE STEPS FOR COMPLETING A SCIENCE ACTIVITY IN THE RIGHT ORDER. USE THE NUMBERS 1-10.

____ Check the results

____ Read all of the directions

____ Gather the materials

____ Complete a reaction sheet

____ Complete the activity in order

____ Turn in your answer sheets

____ Clean up your work area

PUT THESE STEPS IN THE PROPER ORDER. USE NUMBERS 1-3.

If I do not understand what to do when working on a science activity---

___ Ask my group members for help

___ Read the directions 3 times out loud

___ Ask the teacher for help

POST TEST RESULTS

	QUESTIONS									
Subjects	1	2	3	4	5	6	7	8	9	10
1.										
2.		X	X							
3.										
4.					X	X				
5.										
6.										
7.										
8.										
9.										
10.					X	X				
11.										
12.										
13.										
14.							X	X		
15.										
16.										
17.										
18.										
19.						X	X			
20.										
21.										
22.										
23.										
24.										
25.										

APPENDIX G

LEARNING ACTIVITY PACKET

ACTIVITY PACKET

MAGNETS

WELCOME

Get ready to learn
about magnets!
Start with the
introduction-
then follow the
directions to the end!

GOOD LUCK!

MAGNETS

Follow these directions

1. Choose an activity.
2. Read the directions.
3. Gather the materials.
4. Complete the activity.
5. Turn in answer sheets.
6. Clean up your work area.
7. Check-off the activity on your list.

MAGNETS

INTRODUCTION

1. Read the story and mark your answer sheets when told to do so.

2. Materials:
   - 1 horseshoe magnet
   - 1 plastic button
   - 1 rock
   - 1 aluminum pan
   - 1 paper clip
   - 1 copper coin
   - 1 steel washer
   - 1 pencil
   - 1 nail
   - 1 crayon
   - 1 piece of chalk

3. Complete the activity.

11T

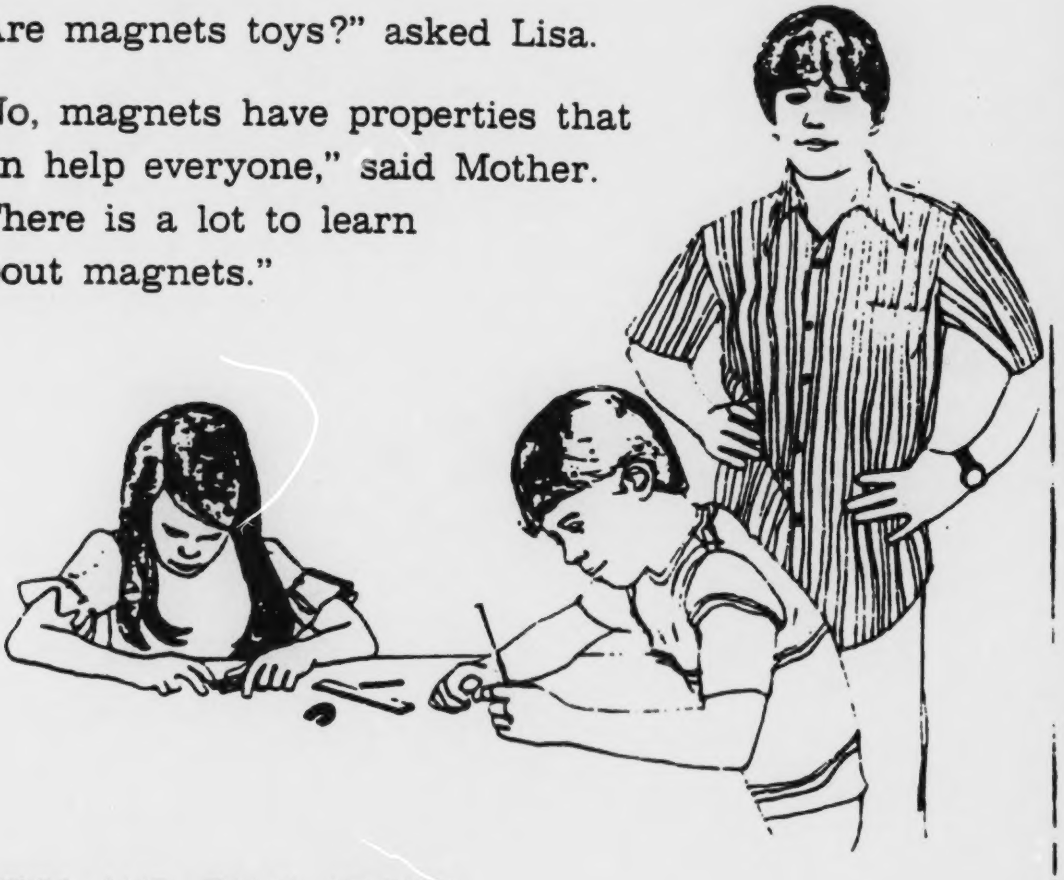
Properties of Magnets

"Want to play with us?"
Lisa asked John.

"No," said John. "Magnets are
just toys for little kids."

"Are magnets toys?" asked Lisa.

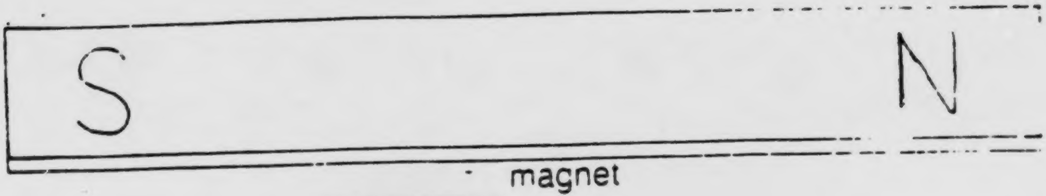
"No, magnets have properties that
can help everyone," said Mother.
"There is a lot to learn
about magnets."



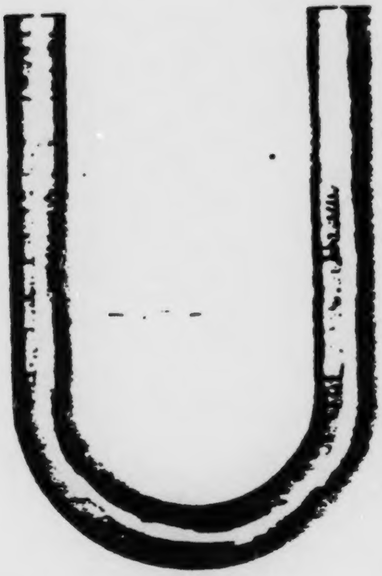
THINK AND TALK ABOUT

1. Tell what you know about magnets.

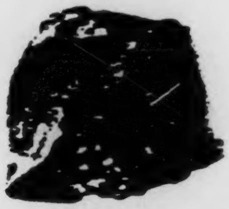
2. Name the magnets you have.



______ magnet



______ magnet



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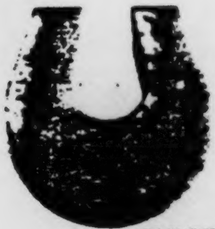
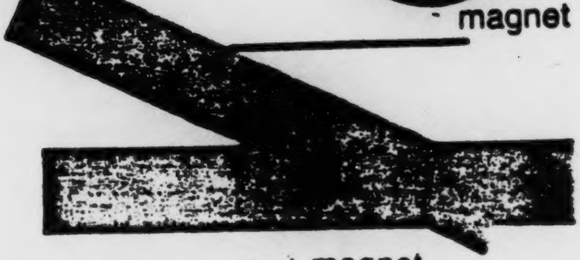
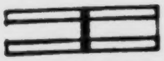


______ magnet



______ magnet

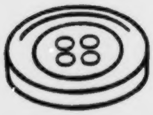


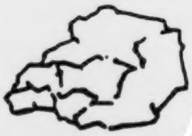
______ magnet

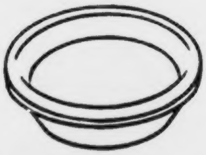
Check your answers.

4 Magnets

1. Draw a ring around each object you think the magnet will pick up.


Plastic button

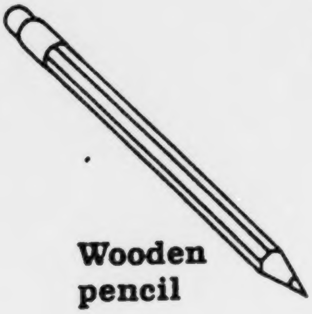

Limestone rock


Aluminum pan

Steel paper clip

Copper coin

Steel washer


Wooden pencil

Steel nail

Wax crayon

Piece of chalk

Test with your magnet.
Put an **X** on each object the magnet did pick up.

Check your answers.

How did you do?

ARE YOU READY TO GO AGAIN?

MAGNETS

ACTIVITY ONE

1. Define the vocabulary in your answer packet.

2. Read the directions.

3. Materials:
   - box of objects
   - 1 horseshoe magnet

4. Complete the activity.

MIGHTY MAGNETS

Use the box of objects to help you decide what a magnet will attract and repel. Draw and label each one.

A magnet will attract these 5 things:	A magnet will repel these 5 things:
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

Turn in your results.

123

You are moving in the right direction!

Move to the next activity!

MAGNETS

ACTIVITY TWO

1. Read the activity.

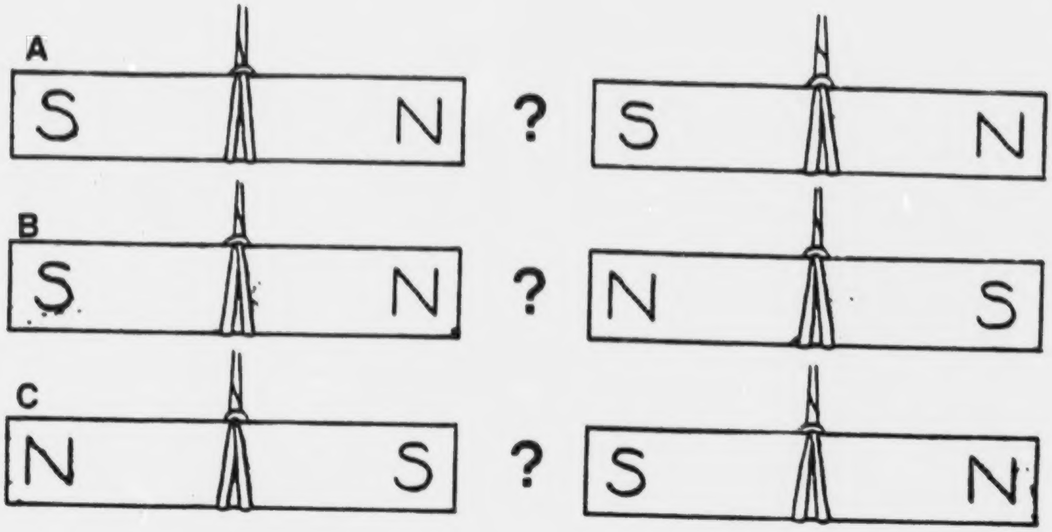
2. Complete the vocabulary in your answer packet.

3. Materials:
    - 2 bar magnets
    - string or yarn

4. Complete the activity.

Sometimes magnets pull toward each other.
Then we say they **attract.**

Sometimes magnets push away from each other.
Then we say they **repel.**



What do you think?
Which pair will attract?
Which pair will repel?
Test to find out.

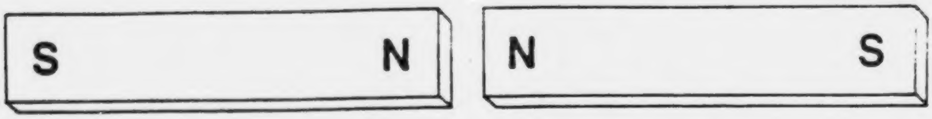
THINK AND TALK ABOUT

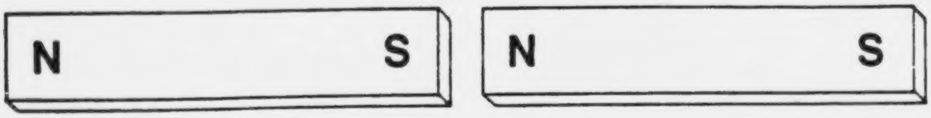
1. When do magnets attract each other?
2. When do they repel each other?
3. What property of magnets does this show?

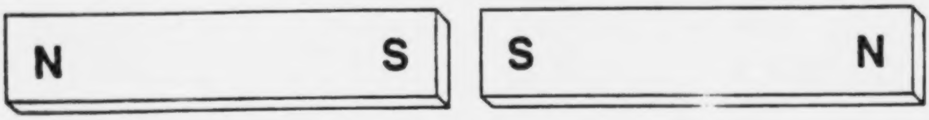
Turn in your answers.

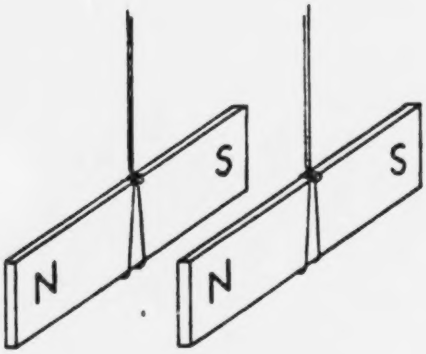
23

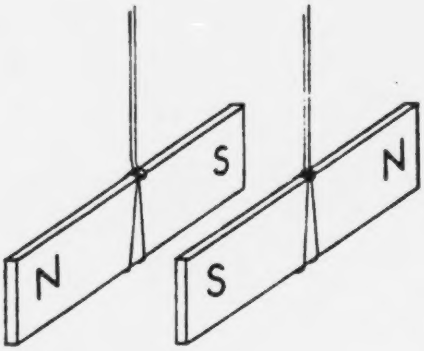
In which sets do you think
the objects will attract?
Draw a ring around each of those sets.









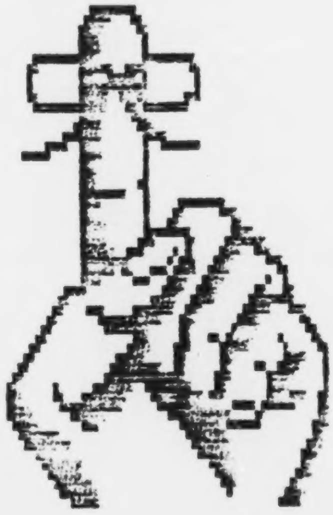


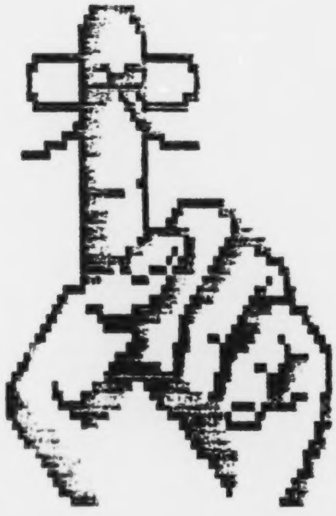
Test and find out.
Put an **X** on each set whose objects did attract.

Turn in your results.

Did you remember to fill in your answers?

If you did... continue!





MAGNETS

ACTIVITY THREE

1. Read the activity.

2. Materials:
   - 3 magnets- different sizes
   - pins
   - 1 horseshoe magnet

3. Complete the activity.

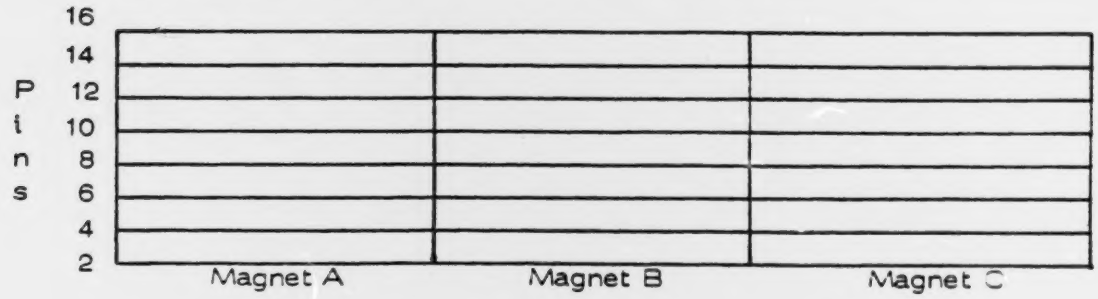
MIGHTY MAGNETS

Choose 3 magnets of different sizes.

1. Which magnet do you think is the strongest? ________

   Why? ______________________________

2. Label each magnet A, B, or C. Using pins, test to see which attracts the largest number of pins. Fill in the graph.

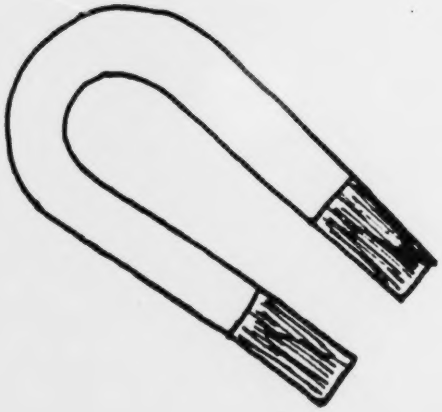


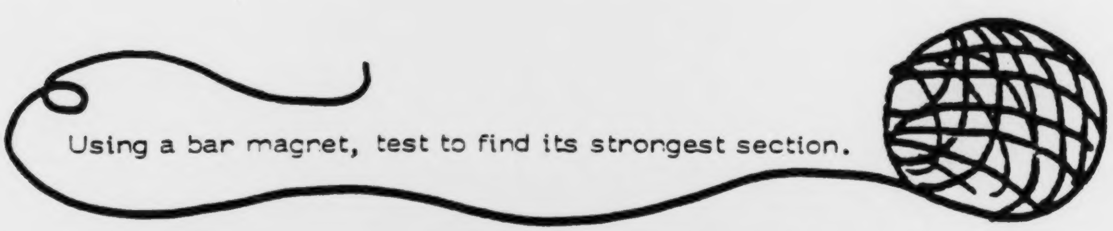
3. Choose a horseshoe magnet. Draw on the magnet the number of pins each end will attract and the number of pins the middle will attract.

The strongest part of a magnet is the

____

________________.





Using a bar magnet, test to find its strongest section.

Turn in your results.

How did you do?

ARE YOU READY TO GO AGAIN?

MAGNETS

ACTIVITY FOUR

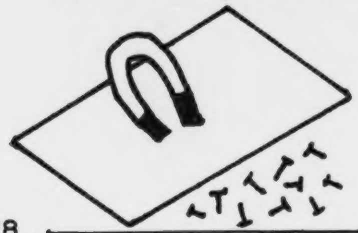
1. Read the activity
2. Materials:
   - 1 horseshoe magnet
   - pins
   - 1 piece of paper
   - 1 piece of cardboard
   - 1 piece of cloth
   - 1 mirror
   - 1 piece of tin
   - 1 piece of plastic
   - 1 piece of wood
   - a bowl of water
3. Complete the activity.

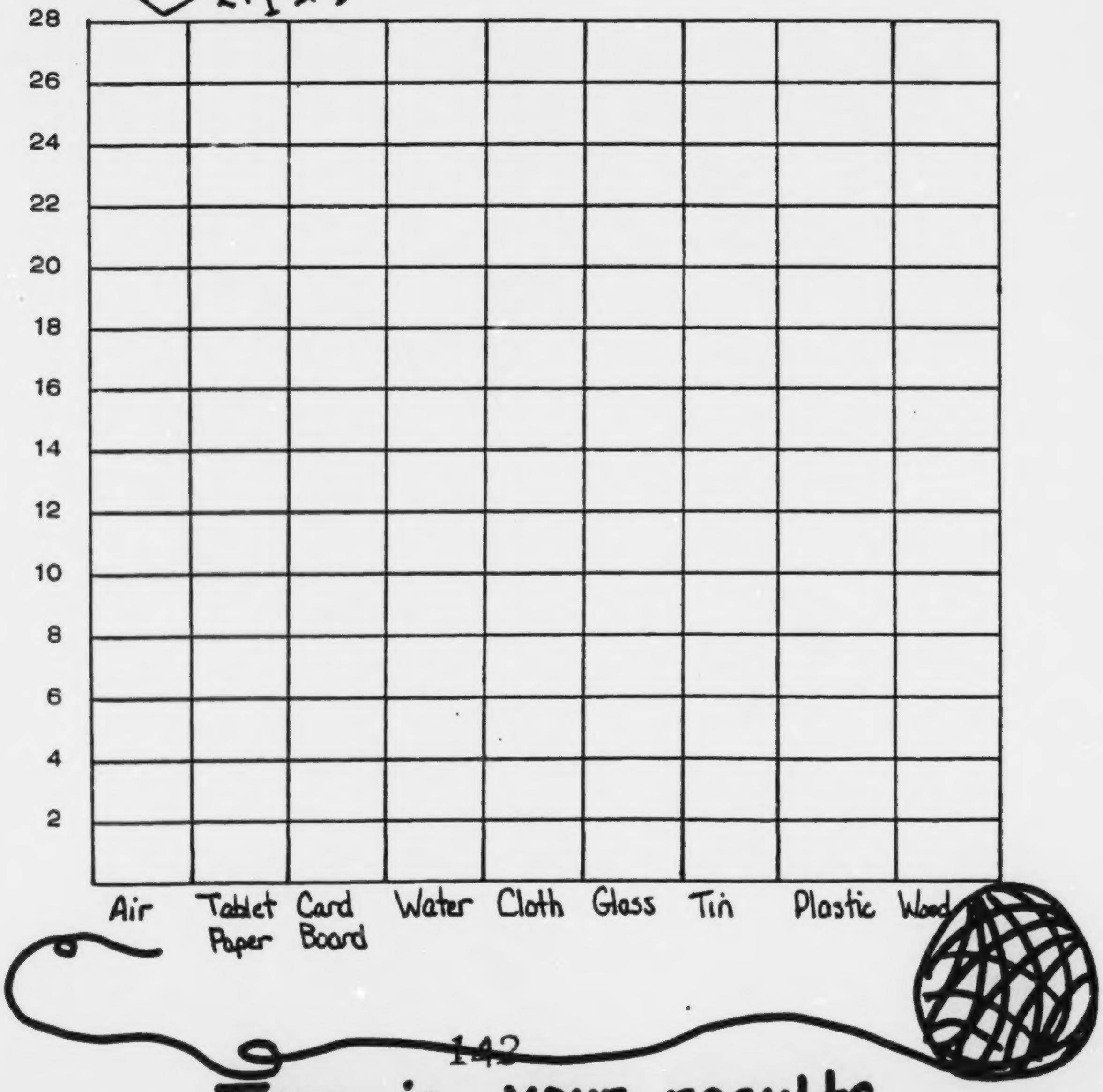
MIGHTY MAGNETS

Use one magnet to test the strength of magnets through various substances.

1. List the number of pins this magnet can attract. ____

2. Test to see if the materials listed below will interfere with the magnets' attraction. Fill in the chart.





Turn in your results.

You are moving in the right direction!

Move to the next activity!

MAGNETS

ACTIVITY FIVE

1. Read the directions.

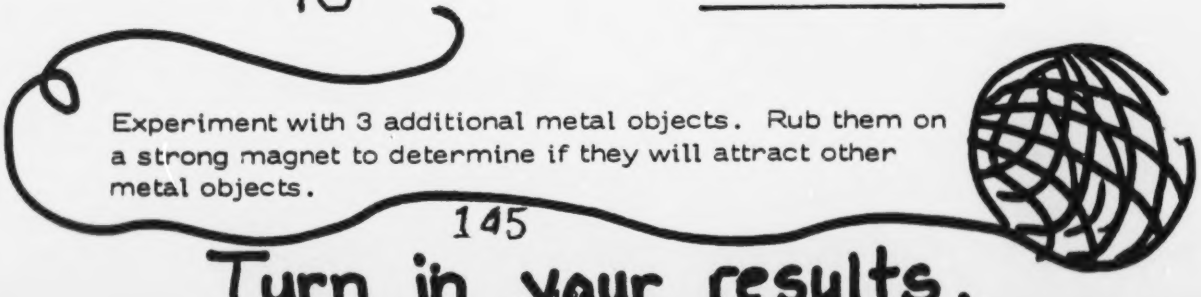
2. Materials:
   - 1 nail
   - 1 bar magnet
   - paper clips

3. Complete the activity.

MIGHTY MAGNETS

Make a magnet from a nail. Use a strong magnet and rub a nail on the magnet until it will pick up a paper clip. Then rub the nail five more times and see how many paper clips the nail will pick up. Continue to rub the nail to determine how many more paper clips the nail will pick up. Record it on the chart below.

Number of times nail is rubbed:	Number of paper clips picked up:
5	________
10	________
15	________
20	________
30	________
40	________



Experiment with 3 additional metal objects. Rub them on a strong magnet to determine if they will attract other metal objects.

Turn in your results.

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Did you remember to fill in your answers? If you did... continue!

MAGNETS

ACTIVITY SIX

1. Read the story.
2. Answer the questions.
3. Try the challenge!

Using Magnets

"Hey, John," called one of his friends.
"Let's go play ball."

"Be right there," John shouted.
As he jumped up, he knocked over
Mother's box of pins.

"Oh, John! See what you did.
Don't go till all the pins
are picked up!" Mother said.

He picked up pins and more pins
and more pins.

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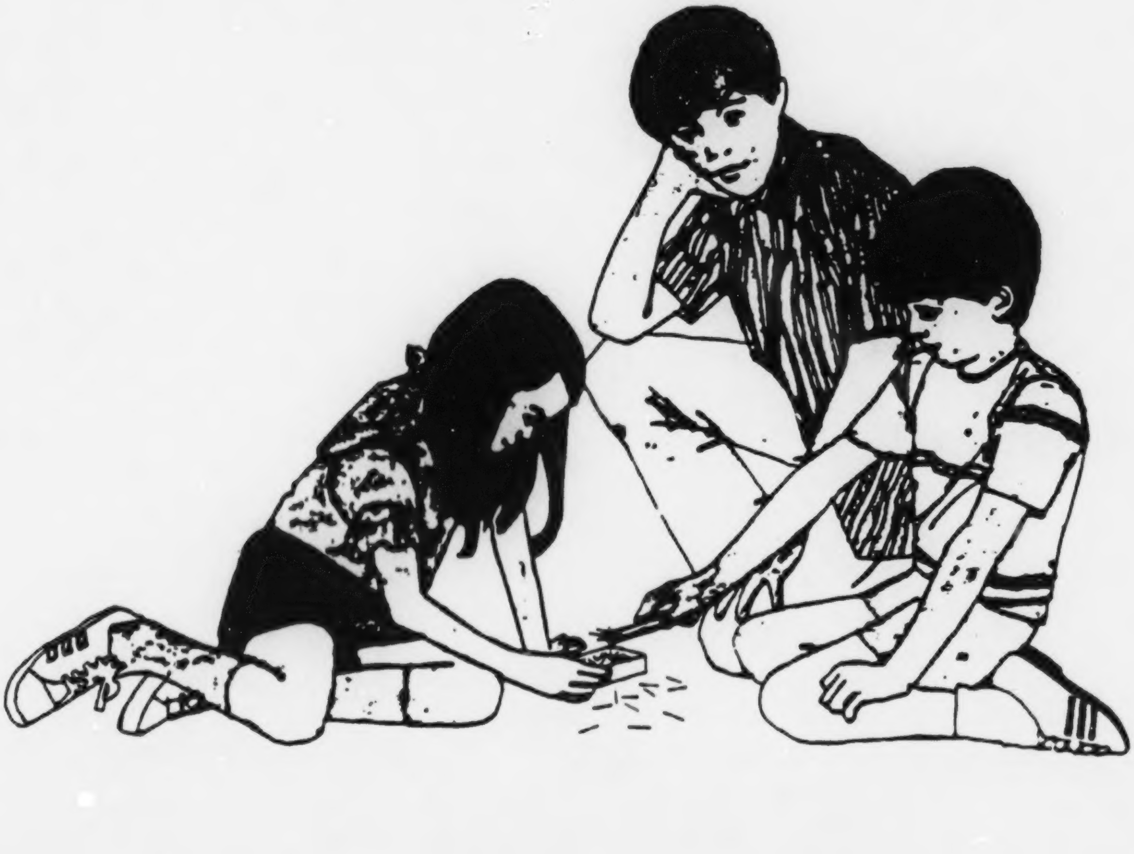
"You really did it this time," said Lisa.

"You sure are slow," teased Pat.

"I suppose you could do it faster," said John.

Lisa and Pat laughed. They pulled magnets from their pockets. Soon the pins were back in the box.



When John came home for supper,
he had news.

"Jim got a little piece of steel
in his eye," he said. "You know
how the doctor got it out? He used a
magnet. I guess magnets aren't just
toys for little kids."

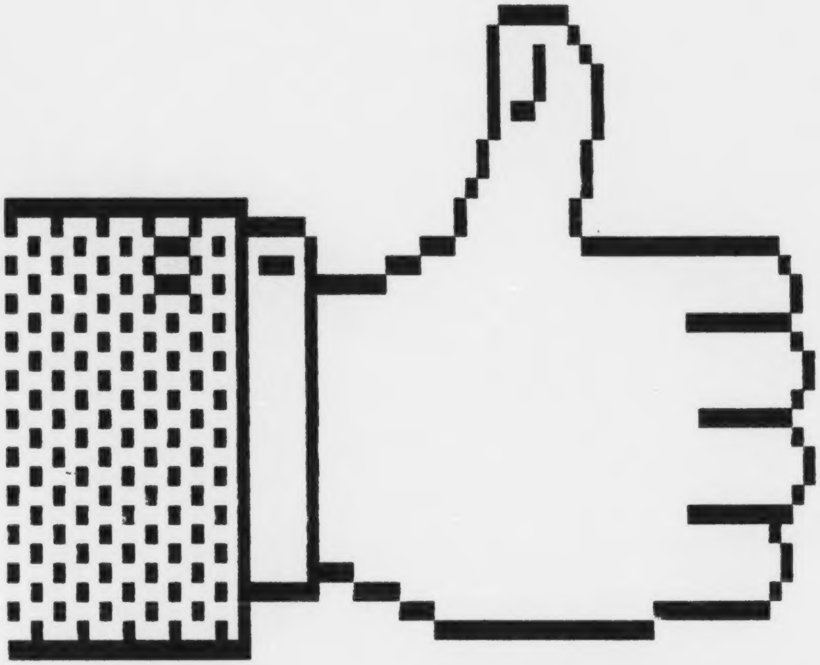
"I guess not," said Mother.
She lifted a small magnet
from the side
of the refrigerator
and took down
her shopping list.

THINK AND TALK ABOUT

1. How many ways are magnets used in the story?
2. How do you use magnets?
3. Does your mother or father use magnets?
4. See how many uses you can find.

Turn in your answers!

YOU DID IT!



YOU FINISHED THE FIRST PACKET!

This certifies

that

____

has completed

the learning

packet

Magnets

____

Name____________

REACTION SHEET

MAGNETS

1. Did you think the activities were interesting? Which was your favorite? ____

____

____

2. Did you find any of the activities hard to understand or do? ____

____

____

3. How did you feel about working in a group without the teacher? ____

____

____

OPTIONAL

4. If you could change anything about the center or the activities, what would it be? ______________________________

____

APPENDIX H

STUDENT ANSWER PACKET

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ACTIVITY PACKET

MAGNETS

Answer Sheets

Name ____________________

MAGNETS

	✓ when started	✓ when turned in	✓ after conference	dates	
				start	finish
Introduction					
Activity 1					
Activity 2					
Activity 3					
Activity 4					
Activity 5					
Activity 6					

MAGNETS
ACTIVITY

Introduction

[illegible] OPTION

1. TELL WHAT YOU KNOW ABOUT MAGNETS.

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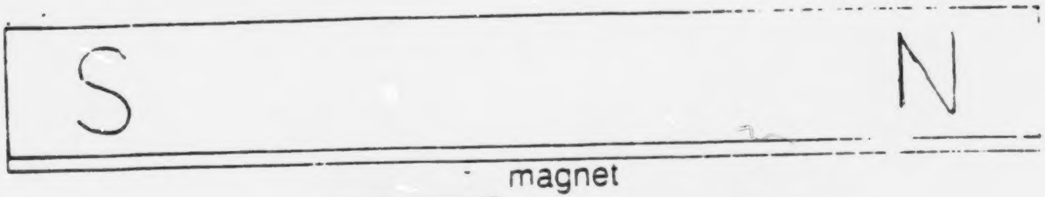
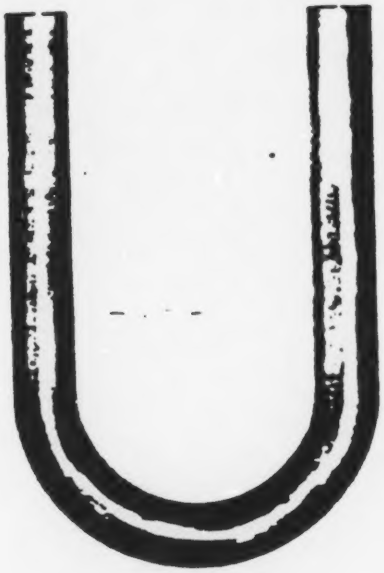
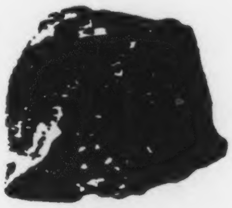
2. Name the magnets you have.



________ magnet



________ magnet



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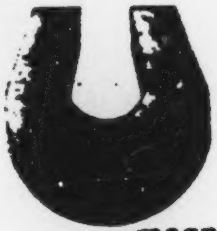
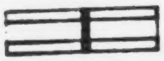


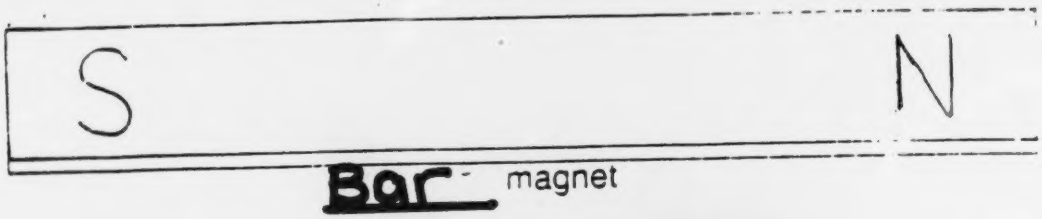
________ magnet

________ magnet

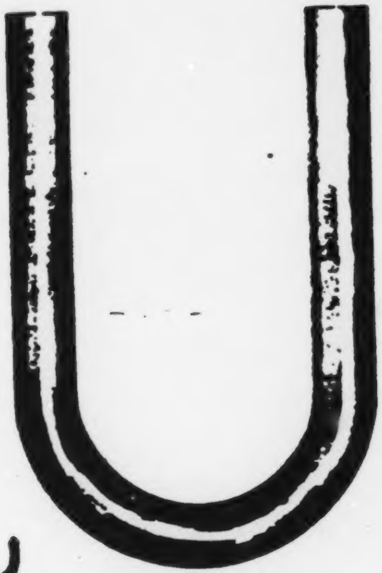


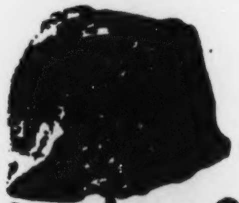
________ magnet

2. Name the magnets you have.



Bar magnet

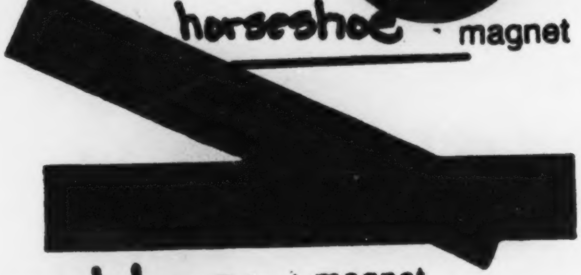




lodestone

horseshoe magnet

U magnet

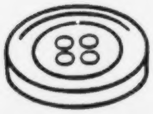


rubber magnet

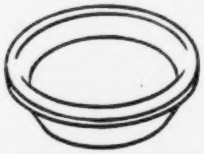
miniature magnet

4 Magnets

22 1. Draw a ring around each object you think the magnet will pick up.


Plastic button

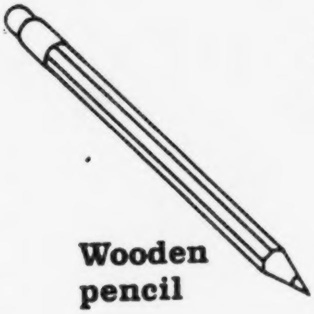
Limestone rock


Aluminum pan

Steel paper clip

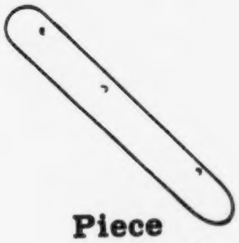
Copper coin

Steel washer


Wooden pencil

Steel nail

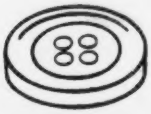
Wax crayon


Piece of chalk

Test with your magnet.
Put an **X** on each object the magnet
did pick up.

4 Magnets

1. Draw a ring around each object you think the magnet will pick up.



Plastic button

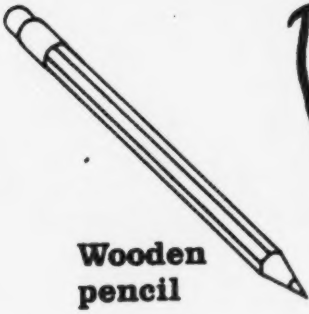
Limestone rock

Aluminium pan

Steel paper clip

Copper coin

Steel washer



Wooden pencil

Steel nail

Wax crayon

Piece of chalk

Test with your magnet.
Put an **X** on each object the magnet did pick up.

MAGNETS ACTIVITY

One

Look up these words
in the dictionary.

Make sure you
understand what they
mean.

1. Attract-

____

____

____

____

2. repel-

____

____

____

____

MIGHTY MAGNETS

Use the box of objects to help you decide what a magnet will attract and repel. Draw and label each one.

A magnet will attract these 5 things:	A magnet will repel these 5 things:
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

MAGNETS ACTIVITY

Two

ACTIVITY TWO

VOCABULARY

ATTRACT ______________________________

REPEL ______________________________

THINK AND TALK ABOUT

1. WHEN DO MAGNETS ATTRACT EACH OTHER?

____

____

2. WHEN DO MAGNETS REPEL EACH OTHER?

____

____

3. WHAT PROPERTY OF MAGNETS DOES THIS SHOW?

____

____

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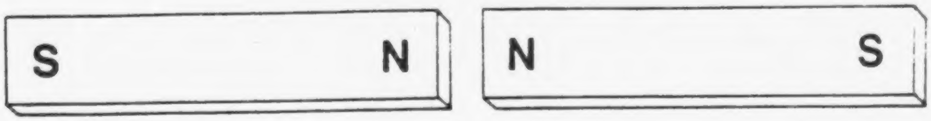
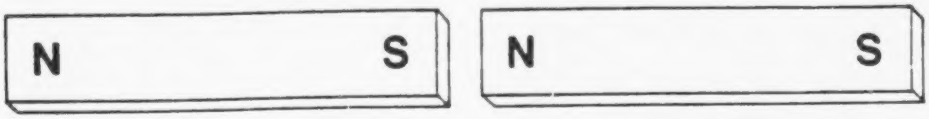
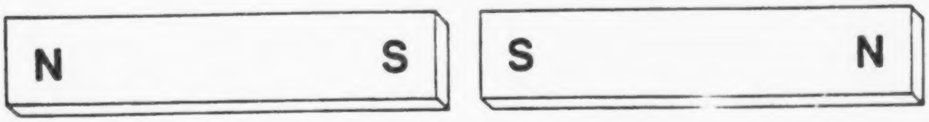
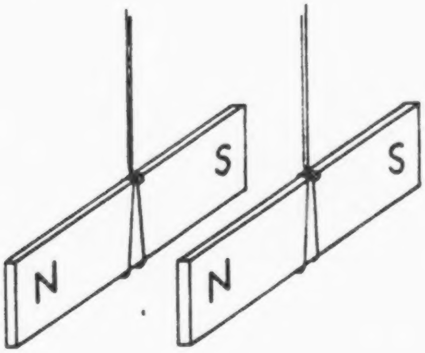
23

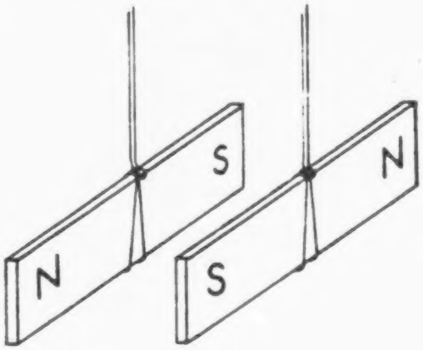
In which sets do you think
the objects will attract?
Draw a ring around each of those sets.











Test and find out.
Put an **X** on each set whose objects did attract.

MAGNETS ACTIVITY

Three

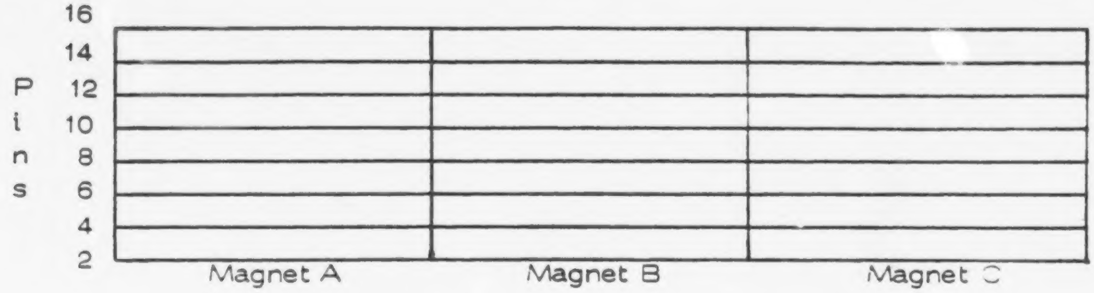
MIGHTY MAGNETS

Choose 3 magnets of different sizes.

1. Which magnet do you think is the strongest? ________

Why? ____________________________________

2. Label each magnet A, B, or C. Using pins, test to see which attracts the largest number of pins. Fill in the graph.

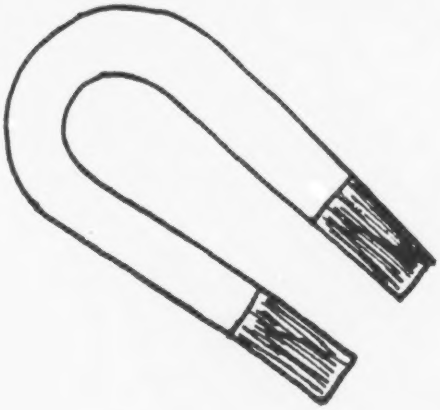


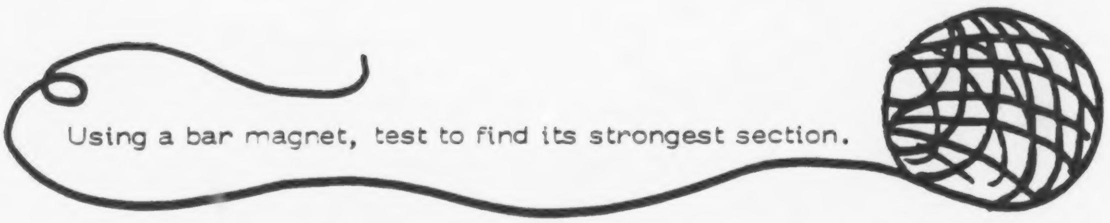
3. Choose a horseshoe magnet. Draw on the magnet the number of pins each end will attract and the number of pins the middle will attract.

The strongest part of a magnet is the

____

________________.





Using a bar magnet, test to find its strongest section.

MAGNETS ACTIVITY

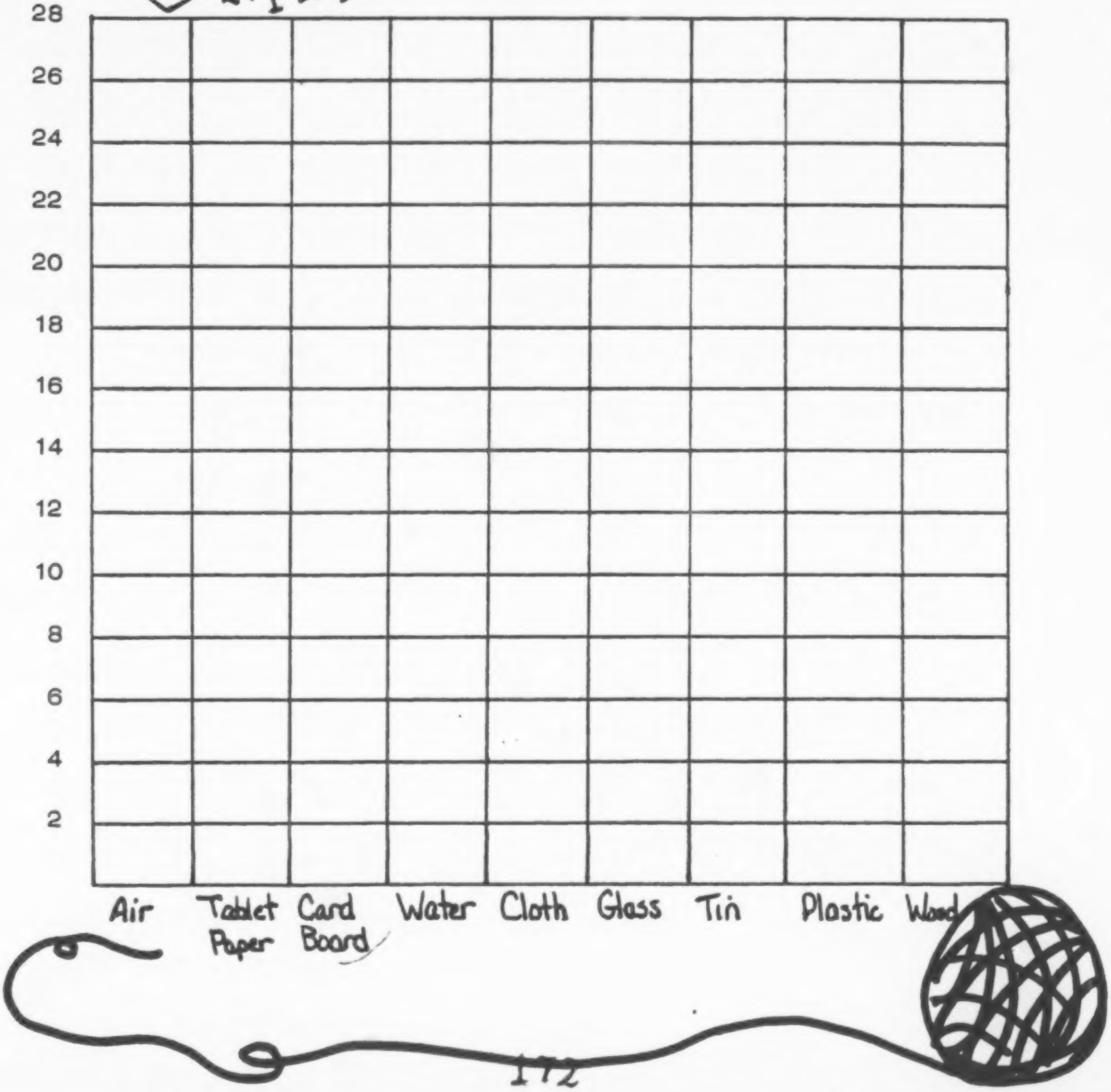
Four

MIGHTY MAGNETS

Use one magnet to test the strength of magnets through various substances.

1. List the number of pins this magnet can attract. ______

2. Test to see if the materials listed below will interfere with the magnets' attraction. Fill in the chart.



MAGNETS ACTIVITY

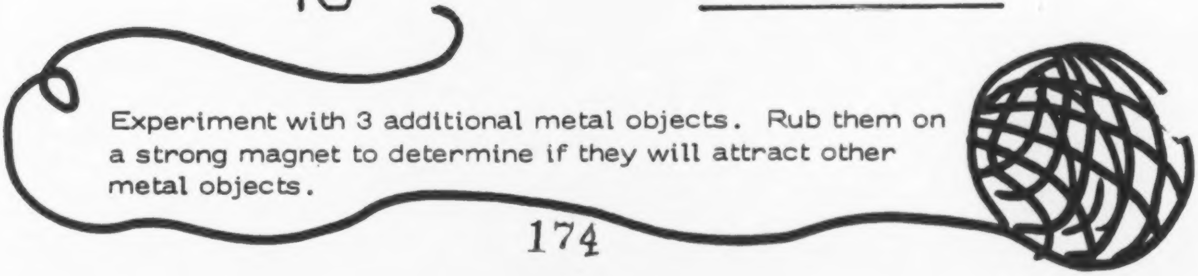
Five

16

MIGHTY MAGNETS

Make a magnet from a nail. Use a strong magnet and rub a nail on the magnet until it will pick up a paper clip. Then rub the nail five more times and see how many paper clips the nail will pick up. Continue to rub the nail to determine how many more paper clips the nail will pick up. Record it on the chart below.

Number of times nail is rubbed:	Number of paper clips picked up:
5	
10	
15	
20	
30	
40	



Experiment with 3 additional metal objects. Rub them on a strong magnet to determine if they will attract other metal objects.

MAGNETS ACTIVITY

Six

ACTIVITY SIX

THINK AND TALK ABOUT

1. HOW MANY WAYS ARE MAGNETS USED IN THE STORY?

____

2. HOW DO YOU USE MAGNETS?

____

____

____

3. DOES YOUR MOTHER OR FATHER USE MAGNETS? HOW?

____

____

4. SEE HOW MANY USES YOU CAN FIND. YOU MUST LIST 3 — TRY FOR MORE!
(You may use books to help you!)

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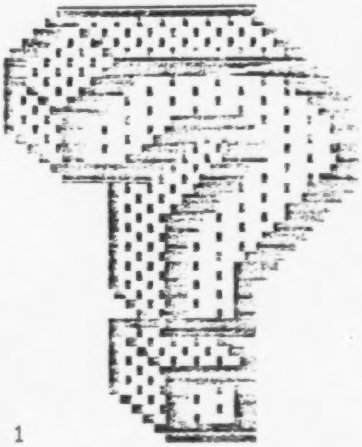
APPENDIX I

ATTITUDE SURVEYS 1-2

What do you think?



ATTITUDE SURVEY 1

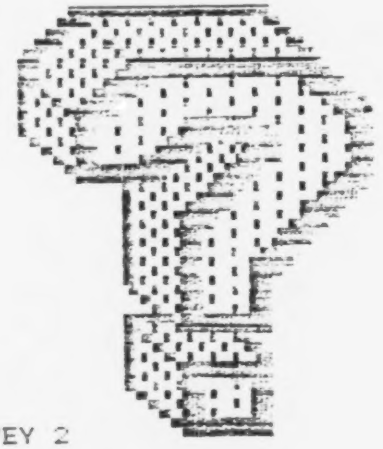
Think about each statement. If it is true for you, circle 1. If it is false for you, circle 3. If you are not sure, circle 2.

1. I like to work by myself.................... 1 2 3
2. I would like more time to work without the teacher. 1 2 3
3. I do not enjoy doing science experiments..... 1 2 3
4. I do not feel good about asking my classmates for help 1 2 3
5. I like to work in small groups 1 2 3
6. The topics of the LAPs sound interesting ... 1 2 3
7. I need my teacher telling me what to do in order to complete my work 1 2 3
8. My classmates can be trusted to follow directions when the teacher is not looking .. 1 2 3
9. I can follow directions 1 2 3
10. I am looking forward to working in the science center 1 2 3

ATTITUDE SURVEY 1-RESULTS

Subjects	Items: 1	2	3	4	5	6	7	8	9	10
1	1	1	3	2	1	1	3	2	1	1
2	2	1	1	2	2	1	2	1	1	1
3	1	1	2	1	1	1	3	2	1	1
4	1	1	2	1	1	1	3	2	1	1
5	1	1	1	1	1	1	3	2	1	1
6	2	1	3	1	2	1	2	2	1	1
7	3	1	1	2	3	1	1	2	1	2
8	2	1	3	1	1	1	2	3	1	1
9	3	1	1	1	2	1	2	3	1	2
10	1	1	3	1	1	1	3	2	1	1
11	1	1	3	2	1	1	3	2	1	1
12	1	1	3	1	1	1	3	2	1	1
13	2	1	1	1	2	1	1	2	1	1
14	2	1	3	1	2	1	2	3	1	1
15	2	1	3	1	3	1	2	3	1	1
16	1	1	1	1	2	1	2	3	1	1
17	2	1	2	1	2	2	2	3	1	2
18	1	1	3	1	1	1	3	3	1	1
19	2	1	3	1	1	1	2	3	1	1
20	1	1	3	1	1	1	3	3	1	1
21	1	1	2	1	1	1	3	2	1	1
22	1	1	2	1	1	2	3	2	1	2
23	1	1	3	1	1	1	3	2	1	1
24	2	1	1	2	2	1	2	2	1	2
25	2	1	3	1	2	1	3	3	1	1

What did you think?



ATTITUDE SURVEY 2

Think about each statement. If it is true for you, circle 1. If it is false for you, circle 3. If you are not sure, circle 2.

1. I like to work by myself.................... 1 2 3
2. I would like more time to work without the teacher. 1 2 3
3. I do not enjoy doing science experiments..... 1 2 3
4. I do not feel good about asking my classmates for help 1 2 3
5. I like to work in small groups 1 2 3
6. The topics of the LAPs sound interesting ... 1 2 3
7. I need my teacher telling me what to do in order to complete my work 1 2 3
8. My classmates can be trusted to follow directions when the teacher is not looking .. 1 2 3
9. I can follow directions 1 2 3
10. I am looking forward to working in the science center 1 2 3

ATTITUDE SURVEY 2=RESULTS

Subjects	Items: 1	2	3	4	5	6	7	8	9	10
1	1	1	3	2	1	1	3	2	1	1
2	2	1	2	3	1	1	2	1	1	1
3	1	1	2	2	1	1	3	1	1	1
4	1	1	3	2	1	1	3	2	1	1
5	1	1	3	3	1	1	3	2	1	1
6	2	1	3	3	2	1	3	2	1	1
7	2	1	2	3	2	1	1	1	1	2
8	2	1	3	2	1	1	2	2	1	1
9	3	1	3	3	1	1	2	2	1	2
10	2	1	3	3	1	1	3	1	1	1
11	2	1	3	2	1	1	3	1	1	1
12	2	1	3	2	1	1	3	1	1	1
13	2	1	2	3	1	1	2	1	1	1
14	3	1	3	3	1	1	3	1	1	1
15	1	1	3	2	2	1	3	1	1	1
16	1	1	2	2	2	1	3	2	1	1
17	2	1	3	3	1	2	2	2	1	2
18	3	1	3	2	1	1	3	1	1	1
19	2	1	3	1	1	1	3	1	1	1
20	1	1	3	2	1	1	3	1	1	1
21	1	1	3	2	1	1	3	1	1	1
22	1	1	3	3	1	2	3	1	1	1
23	3	1	3	3	1	1	3	1	1	1
24	2	1	3	2	1	1	3	1	1	1
25	2	1	3	1	1	1	3	1	1	1

APPENDIX J

CHECKLISTS FOR EVALUATION

GROUP, INDIVIDUAL, PROGRESS

GROUP ____________

TEACHER CHECKLIST: GROUP EVALUATION

1. Do groups have a balanced number of students with differing ability levels? Y or N
2. Do group members share needed materials? Y or N
3. Do group members show patience with one another? Y or N
4. Is one member of the group overly dominant? Y or N
5. Is one member of the group overly passive? Y or N
6. Do students help each other willingly? Y or N
7. Is the group showing appropriate behavior in the Center? Y or N
8. Is the noise level acceptable? Y or N

COMMENTS ____

____

____

____

GROUP EVALUATION-DURING INSTRUCTION

Group	Items: 1	2	3	4	5	6	7	8
1	Y	Y	Y	N	N	Y	-	Y
2	Y	Y	Y	N	N	Y	-	Y
3	Y	Y	Y	N	N	Y	-	Y
4	Y	Y	N	N	N	Y	-	Y
5	Y	Y	Y	N	Y	Y	-	Y

GROUP EVALUATION-DAY ONE

1	Y	Y	N	N	N	Y	Y	N
2	Y	N	N	Y	Y	N	Y	Y
3	Y	Y	Y	N	N	Y	Y	Y
4	Y	N	N	N	Y	N	N	N
5	Y	N	N	Y	N	N	N	N

GROUP EVALUATION-DAY FOUR

1	Y	Y	Y	N	N	Y	Y	Y
2	Y	Y	Y	N	Y	Y	Y	Y
3	Y	Y	Y	N	N	Y	Y	Y
4	Y	Y	Y	N	N	Y	Y	Y
5	Y	Y	Y	N	N	Y	Y	Y

TEACHER CHECKLIST: INDIVIDUAL EVALUATION

Ratings for individual performance.

high — low

Name__________

1. Student located the correct LAP activity. 1 2 3 4
2. Student located his or her answer folder. 1 2 3 4
3. Student read through the directions before begining the activity. 1 2 3 4
4. Student retrievd located and retrieved needed materials. 1 2 3 4
5. Student completed the activity secuentially. 1 2 3 4
6. Student asked group members for help when needed. 1 2 3 4
7. Student properly filled in answer sheeets. 1 2 3 4
8. Student returned materials to their proper place on completion of activity. 1 2 3 4
9. Student turned in completed activity to the teacher. 1 2 3 4
10. Student completed check off sheet properly. 1 2 3 4
11. Student worked for 30 minutes without teacher instruction. 1 2 3 4

COMMENTS: ______________________________

____

____

____

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INDIVIDUAL EVALUATION CHECKLIST RESULTS
DAYS ONE AND FOUR

	Items										
Subjects	1	2	3	4	5	6	7	8	9	10	11
1	3 1	2 1	2 1	2 1	1 1	2 1	3 2	1 1	1 1	2 1	2 1
2	2 1	2 1	2 1	2 1	1 1	3 2	2 1	2 1	1 1	2 1	3 1
3	3 2	1 1	4 2	1 1	1 1	2 2	2 2	2 1	1 1	1 2	2 1
4	4 2	2 2	4 2	1 1	2 1	3 1	3 1	2 2	1 1	2 2	4 1
5	3 1	2 1	3 2	1 1	1 1	3 2	3 2	1 1	1 1	2 1	2 2
6	2 1	1 1	2 2	2 1	1 1	- 1	2 1	3 2	1 1	1 1	1 1
7	2 1	1 1	2 1	2 1	1 1	- 1	2 1	2 1	1 1	1 1	1 1
8	4 2	2 1	4 2	2 1	1 1	3 2	3 2	2 1	1 1	1 1	2 1
9	4 2	2 1	4 2	2 1	1 1	3 3	3 2	1 1	1 1	2 2	4 2
10	2 1	1 1	3 2	1 1	1 1	2 1	2 1	3 2	1 1	1 1	3 2
11	4 2	1 1	2 2	2 1	2 1	3 3	2 1	2 1	1 1	2 2	2 2
12	3 1	2 1	3 1	2 1	1 1	2 1	3 2	3 1	1 1	1 1	3 1
13	3 1	2 1	4 2	1 1	1 1	2 1	2 1	1 1	1 1	1 1	2 1
14	4 2	2 1	2 1	1 1	1 1	2 1	3 1	2 1	1 1	1 1	3 2
15	2 1	1 1	2 1	2 1	1 1	3 2	3 2	2 1	1 1	2 2	3 1
16	3 1	2 2	2 1	1 1	2 1	2 1	2 1	1 1	1 1	1 1	4 2
17	2 2	2 1	2 1	2 1	1 1	3 2	2 1	1 1	1 1	2 1	3 1
18	3 2	1 1	3 2	2 1	1 1	4 2	3 2	2 1	1 1	2 1	3 1
19	3 1	2 1	2 1	2 2	1 1	4 2	3 2	1 1	1 1	2 1	2 2
20	2 1	1 1	4 2	2 1	1 1	3 2	2 1	1 1	1 1	1 1	3 1
21	2 1	1 1	2 1	2 1	1 1	3 1	2 1	1 1	1 1	2 1	4 2
22	4 2	1 1	2 1	2 1	2 1	3 1	2 1	2 2	1 1	2 2	3 2
23	3 2	2 1	3 1	1 1	2 1	4 2	3 1	2 2	1 1	1 1	2 1
24	3 1	1 1	2 1	2 2	1 1	3 1	2 1	2 1	1 1	2 1	3 1
25	2 1	2 1	2 1	2 1	1 1	3 1	3 1	2 1	1 1	2 1	2 1

Mrs. Geiger's Class - 308 **MAGNETS** 17

	Name	Intro ✓	Redo	One		Two		Three		Four		Five		Six			
1	Samantha																
2	David Basta																
3	Michael																
4	Elizabeth																
5	David Bruno																
6	Stephanie C.																
7	Stephanie Carl																
8	Nicholas																
9	Lisa																
10	Alfonse																
11	Matthew																
12	John																
13	Robert																
14	Heather																
15	Tricia																
16	Anthony																
17	Nicole																
18	Michelle																
19	Janis																
20	Ian																
21	Tracy																
22	Timothy																
23	Brian																
24	Christopher																
25	Jill																

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